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BIOLOGY AND PATHOLOGY OF FARM-BRED FUR-BEARING ANIMALS

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General Papers

DEVELOPMENT OF FUR FARMING IN CONSUMER COOPERATIVES PRESENT STATE AND PROSPECTS

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The Tenth Five-Year Plan set many tasks for the agricultural sector in order to ensure further development and stabilization of production, and to make all-round improvements in the efficiency of agriculture and animal breeding. These were needed to meet more efficiently the people's requirements for food products and industrial raw materials, and to generate the necessary state reserves of agricultural products.

The workers on the fur farms fulfilled the resolutions of the Twenty-fifth Congress of the Communist Party of the Soviet Union and achieved positive results. Thus, they contributed their valuable share in fulfilling the national plan.

At present, the pelts of farm-bred, fur-bearing animals account for 95 percent of the fur production of the country. The USSR has become the leading producer of fur products in the world, surpassing the USA. These achievements of Soviet fur breeders have been made possible due to the overall rise in the economic level of the country, distinct specialization and concentration in the production of fur products, and control by the concerned local associations.

Fur farms of the consumer cooperatives have successfully discharged their socialistic obligations and fulfilled the fur production targets of the Five-Year Plan in four years. Fur valued at 640 million rubles was produced and supplied to the state in the period 1971 to 1975, against the Plan target of 531.7 million rubles.

The production of mink, silver-black fox, blue fox, and coypu pelts by the consumer cooperatives was 1.9 times greater in the Ninth Five-Year Plan than in the preceding Plan.

At present, the production of furs by the consumer cooperatives is as high as it is in countries such as Denmark, Sweden, Canada and Finland.

During the Ninth Five-Year Plan, there was an increase in the population of fur-bearing animals on the fur farms of the consumer cooperatives; the qualitative composition of the herds improved and commercial production increased steadily over the years. During this period, the main herd as well as the population of fur-bearing animals increased over twofold on the fur farms of the Russian Soviet Federative Socialist Republic, Byelorussian,

and Uzbekistan consumer cooperatives. Fur production on the cooperative farms also doubled in this period.

In this period, the investment in the consumer cooperatives rose from 94.4 to 172.3 million rubles and the profits increased from 8.1 to 16.5%.

The Plan for the first year of the Tenth Five-Year Plan for the production of fur products has been successfully fulfilled by the consumer cooperatives in the various Republics.

In 1976, the cooperative fur farms supplied to the state 3,410.6 thousand pelts valued at 174.2 million rubles. Compared to 1975, the annual increment in fur production worked out to 400.5 thousand, equivalent to 20.2 million rubles, or 11.5%.

The profitability of fur farming, which represents a basic index of the economy, rose from 16.5% in 1975 to 18.4% in 1976.

On January 1, 1977, there were 186 fur farms in the consumer cooperatives, with 964.4 thousand animals in the main herds.

However, in spite of a significant rise in the production of fur products, the indigenous demand and export requirements are far from being fully met. The success of the cooperatives would have been even more significant had all of the intra-farm resources been more fully utilized for further enhancing the bulk of fur production, thus leading to a more rapid increase in the efficiency of fur farming.

Rational utilization of all resources to facilitate increased profitability of fur production is the most important problem facing fur farms.

I. Under present-day conditions, the important factors responsible for enhancing the efficiency of fur farming are the increase in the animal population and the enlargement and specialization of the farms. This can be strikingly demonstrated by the operation of such extremely large consumer cooperative fur farms as Kretungsk in Lithuania, Vyatka of the All-Union Scientific Research Institute of Game Management and Fur Farming, Gagarin Farm of the central fur cooperative in the Russian Soviet Federative Socialist Republic, Sokalsk Farm in Lvov and Pinsk and the Molodechnensk farms of the Byelorussian fur cooperative, each of which produces products worth 3-5 million rubles annually, making a profit of over a million rubles. The annual product yield per worker averages 12,000-17,000 rubles, which is significantly higher than the average for the All-Union Consumers' Cooperative Society.

Increasing production and narrowing down the specialization of production improve profitability due to a reduction in the cost of production and better utilization of resources. This results in an overall increase in production and labor output, with the additional help of zoological and veterinary services. Therefore, concentration of fur farms within the consumer cooperatives is the most important avenue for enhancing the economic efficiency of farm breeding.

At present large ranches producing fur on a commercial scale play a leading role in fur farming. Farms producing fur worth over a million rubles are in divisions 54 and 192 and account for 62% of production.

Specialization reflects the qualitative side of the process and determines what types of products will be the major ones on any given ranch.

Regarding the total production of fur products, in monetary terms in 1976, the contribution of mink breeding was 64.5%, blue fox breeding 28.0%, silver black fox breeding 7.3% and coypu breeding 0.2%.

2. Greater possibilities for improving the profitability of fur farming are associated mostly with improving the quality of the products further, increasing the reproduction rate of animals, and enhancing labor productivity.

In 1976, as compared to 1975, the consumer cooperatives raised the sale price of a silver-black fox pelt by 3 rubles 30 kopeks, a mink pelt by 57 kopeks, and a coypu pelt by 43 kopeks. The price of a blue fox pelt was reduced by 22 kopeks.

The majority of fur farms incur huge losses in disposing of the pelts, primarily because of their inadequate size.

Significant improvements in product quality, as a rule, are the result of prolonged, meticulous and dedicated work. It has been computed that by increasing the price of pelts by only 1% as compared to the average indices in the consumer cooperatives, an additional profit of over 1.7 million rubles could be realized.

3. During the last years of the Five-Year Plan period one of the main problems of fur farming has been to ensure a significant increase in the net yield of minks, blue foxes and silver black foxes, without impairing the quality of the fur. Increasing the output of the animals, while at the same time building up their population, represents the basic approach to the increased profitability of fur farming.

4. Improving labor output is the most important condition for enhancing production and reducing costs. The lack of mechanization of labor intensive processes on the fur farms of the consumer cooperatives is holding up the tempo of labor output. Therefore, mechanization of labor intensive processes remains an important problem facing fur farms in the Tenth Five-Year Plan.

Further developments in fur farming should be aimed at perfecting the technology of rearing the animals, enhancing the herd and breeding better varieties of the animals, as well as introducing technological production devices and complex mechanization of work on the farms. Thus, along with a significant increase in production and in labor output, there would be a decrease in the cost of production and improvement in the quality of the product.

During the Tenth Five-Year Plan of the All Union Consumers' Co-

operative Society, the output of furs should be raised at least 1.4 times. By 1980, every fur farm should have about 15,000 fertile minks and up to 3,000 blue and silver-black foxes, and the profitability of the cooperative fur farms should be raised by up to 25%.

FUR FARMING UNDER THE SOVIET RULE PRESENT STATE AND PROSPECTS

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The Soviet government completes its 60th year in November 1977

During these years of Soviet rule Russia has been transformed into a mighty economic power with highly developed industry and agriculture. It is now the world's leading producer of many important products.

The socialist planning system has ensured the accelerated growth of the country's economy, and the evolution and well-being of new branches of industry and agriculture including fur farming, or the fur industry as it is called abroad.

The breeding of fur-bearing animals in pens—minks, silver-black foxes, blue foxes, sables and coypus—is a new, rapidly growing branch of animal breeding, which is needed to compensate for the deficiency of natural furs.

It is well known that the supplies of furs through hunting have been steadily declining as a result of industrialization and commercial development of the northern areas. Thus, hunting cannot meet the fur requirements of the growing population with its increasing prosperity, and the requirements for export.

Commercial breeding of fur-bearing animals in pens was started in the Soviet Union during the First Five-Year Plan period, when the Gostorg (State Trading Organization) organized a few state fur farms (Pushkinsk and Saltykovsk in Moscow district, Shirshinsk in Arkhangelsk district, Tobol'sk in Tyumen district, Putyatinsk in Primory'e region, and others). At the same time, scientific studies were begun on the breeding of fur-bearing animals and the training of highly qualified veterinary personnel and breeders was undertaken.

However, in the pre-War years and in the years of the Great Patriotic War, fur farming was not highly developed and the state fur farms produced only 26,000 pelts (1946). The establishment of fur farming as a distinct branch took place in the postwar period, especially during the last 15 years (Table 1).

In 1976, the fur farms supplied to the state 11 million pelts valued at over 0.5 million rubles at the purchase prices. This accounted for 95% of the total pelt supplies in the country. Large specialized state fur farms (producing eight million pelts) and farms of the All-Union Consumers' Cooperative Society (three million pelts) produce these furs.

The Soviet Union is now the world's leading producer of farm-bred furs.

Table 1. Pelt supplies by fur farms in the different postwar Five-Year Plan periods (1945-1975) and the supply target for 1976-1980 (in thousands)

Type of pelt	1946-1950	1951-1955	1956-1960	1961-1965	1966-1970	1971-1975	1976-1980	Total
Mink	110	525	1,236	10,163	19,818	37,424	48,405	117,681
Blue fox	46	122	795	1,976	2,937	4,536	5,259	15,671
Silver-black fox	241	670	1,590	1,933	2,043	1,914	1,798	10,189
Coypu	25	34	227	436	499	335	290	1,846
Sable	2	7	15	21	29	49	70	193
Total	424	1,358	3,863	14,529	25,326	44,258	55,822	145,580

The Tenth Five-Year Plan envisages a further increase in fur production. For the five years as a whole, the production of 55 million pelts of mink, blue fox, silver-black fox, sable and coypu, valued at 2.7 million rubles at prevailing purchase prices, has been envisaged. For this, 43.2 million pelts or 78% of the entire production of the country is to come from the Russian Soviet Federative Socialist Republic.

The regional specialized control boards of the state fur farms, which came into being in the postwar years, and also specialization and concentration in the production of farm fur products have promoted the development of fur farming. At present, the level of specialization in fur production on the state fur farms is very high. 90% of their total revenue is from pelts.

The state fur farms represent the largest of their kind in the Soviet Union as well as in the world. On January 1, 1977, an average-sized state farm had 15,000 female minks in the main herd, the population went up to 18,000 females by the end of the Tenth Five-Year Plan period. Concentration of fur farming and strengthening of the existing fur farms are taking place in the All Union Consumers' Cooperative Society as well.

One of the important factors which promoted the growth of indigenous fur farming was the harmony between science and production techniques, since right from their inception the scientific institutions worked within the framework of a single division. The fruitful cooperation between science and production techniques helped to evolve, within a short period, completely new scientific principles of rearing, feeding and veterinary prophylaxis of farm-bred, fur-bearing animals. This helped the Soviet fur industry to outstrip the fur farms of the USA, Canada and Scandinavia in the output of juveniles of all types of fur-bearing animals and, what is more important, to organize a group of scientific personnel and field workers, such as highly qualified fur farmers capable of resolving the most intricate problems. Thus, for example, many problems were solved regarding the rearing of black sables, known only on the state fur farms of the Russian Soviet Federative Socialist Republic, their farm-breeding is a monopoly of the Soviet Union.

The breeders of the Russian Soviet Federative Socialist Republic will be entering the 60th year of Soviet rule by fulfilling on time the tasks of fur production set before them by the state. The state farms of the All Russian Production and Scientific Basis of the Fur Farming Industry nearly doubled fur production during the period 1970-1975 and fulfilled the Ninth Five-Year Plan targets in four years. In 1976, the targets set in the national plan were surpassed and the branches made a successful start on the Tenth Five-Year Plan by increasing fur production 10% compared to that of 1975 (Table 2).

The reproduction rate of the animals rose significantly: it was 4.64 per female mink, a 0.2% increase over 1975, 7.61 per female blue fox (0.34% more), 4.33 per female silver-black fox, 2.23 per female sable and 7.47 per

Table 2. Fur supplies to the government by the state and collective ranches of the Ministry of Agriculture, Russian Soviet Federative Socialist Republic in 1976

	Total value of furs produced, thousand rubles	Pelts according to type (in thousands)					Total
		Mink	Blue fox	Silver-black fox	Sable	Coypu	
State fur ranches	323,528	6,366 8	227 4	87 8	10 7	16 9	6,709 6
State and collective ranches of the Far North	15,866	90 8	87 7	53 2	—	—	231 7
Total	339,394	6,457 6	315 1	141 0	10 7	16 9	6,941 3

a significant increase in the population of farm bred carnivorous fur bearing animals on the state and collective farms and on the farms of the consumer cooperatives will not be possible in the immediate future, because of the limited feed resources of animal origin. In the rearing of carnivorous fur bearing animals, we have come close to the optimum level, our efforts should be directed toward the organizational and economic strengthening of the existing farms (no new state fur farms), their technological equipment, increasing the reproduction rate of females and raising the quality and range of fur products.

There is no doubt that the population of black sables and colored varieties of silver black and blue foxes will have to be increased. The farming of Ussurian raccoons will have to be restored to moderate proportions and there should be some farms for rearing black European polecats, the pelts of which are now highly priced in the export market. The time has come to take up seriously the use of plant food while raising fur bearing animals, primarily the coypu, which provides tough furs of diverse colors and is in great demand for the local and export markets. The development of industrial technology should be accelerated for the breeding of coypu with a minimum water intake (mainly for drinking) while keeping the animals in closed buildings without any basins for their bathing. The purchase price of coypu pelts should be raised.

Improving the overall labor output by reducing the labor input per kit raised is the most important task of every fur farm.

The farms could realize lower labor input by increasing the number of animals under the charge of one worker to 250-300 females producing up to five young each by semiautomatic feeding of the animals with mobile feed distributors in the summer autumn period, by means of which one woman worker could ensure the feed supply to 12 000-15,000 animals, by mechanical scavenging of refuse, and by watering the animals with a hose. Reducing the width of the pen (35 cm for the main herd and 30 cm for the young) and closing the pens and enclosures would enable the shed capacity to be raised by 20-30%. These are important points in reducing the labor involved in handling minks.

At present, the Institute of Fur Farming and Rabbit Breeding, and field workers engaged in fur farming, are working on industrial technology for fur production by total mechanization of labor intensive processes for use on large state farms holding a main herd of 25,000-30 000 females, each with an annual production of 6-8 million rubles. Specialization of such large farms for the rearing of a single type of fur bearing animal and of their units for the rearing of animals of a single color promotes effective kitten yield and fur quality, and ensures a further increase in production per worker.

The large state fur farms are like factories producing fur, each having

several thousand fur-bearing animals. They protect the animals from severe infectious diseases by effective vaccinations using indigenously produced vaccines against distemper, botulism, virus enteritis, pseudomonas, paratyphoid, virus hepatitis and leptospirosis. Indeed, the development of these vaccines owes much to the efforts of Soviet scientists. In order to reduce the labor involved in vaccination, work should be intensified in the scientific and research institutions to develop combined vaccines and vaccines which could be administered in the form of aerosols.

The main avenues for enhancing greater production of kittens are still a reduction in the mortality of the young before decreasing sterility among females, a reduction in embryonic mortality of the fetus, prevention of toxicosis of pregnancy, short lactating periods of females and so on. The efforts of our scientists, zoologists and veterinarians should be directed toward solving these problems.

Technical equipment on the state fur farms has increased considerably as a result of mechanization and availability of electrical power from the state grid. The feed preparation kitchens of state farms are equipped with powerful processing machines made by the Erti'sk Mechanical Works. With the help of these, it should be possible to achieve continuous feed preparation on each farm, followed invariably by homogenization, while loading into the transport system for carrying it to the point of consumption. Refrigeration devices on the state farms have increased; in 1976 alone, the state farms commissioned refrigeration devices with a total capacity of 29,000 tons. The automatic feed distributors supplied to the state fur farms every year are supervised by female workers; other equipment supplied are degreasing machines and devices for the preliminary processing of pelts, refrigerated transport systems, etc.

Further developments in fur farming and improvements in the qualitative indices of the operational system of state fur farms will be possible only when there is constant care by scientific and research wings and when their scientific and production resources are strengthened. Our task is to transform the Institute of Fur Farming and Rabbit Breeding along with the experimental-demonstration farm and Control Bureau and the experimental factories, all at present under the All-Russian Production and Scientific Combine of the Fur Farming Industry, into a divisional center for scientific and technological progress. During the last five years, six million rubles have been invested in the construction of a scientific and technological production base at the Institute and five million rubles more will be spent before the end of the Tenth Five-Year Plan period. In order to strengthen the relationship between science and production, five scientific research laboratories under the Institute have been opened in different zones of the Russian Soviet Federative Socialist Republic. The Institute has been strengthened with five base farms for testing and quick application of the results of scientific

research to production. In 1976, 12-25 scientific innovations were introduced at each of these state farms. The Institute has a school attached to it for improving the qualifications of the workers on state fur farms. The Control Bureau of the Institute, along with experimental work, plans for the reconstruction of the breeding farms and feed preparation centers. It designs and builds new production machines and equipment for use on the state fur farms.

The collective workers on the state fur farms in the Russian Soviet Federative Socialist Republic have instituted a socialist competition for all people to improve production efficiency and product quality. They enter the 60th year of Soviet rule by surpassing all of the targets set for the second year of the Tenth Five-Year Plan.

STUDIES CONDUCTED AT THE VNIIOZ ON FUR FARMING

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The scientific investigations of the All-Union Scientific Institute of Game Management and Fur Farming are directed at fulfilling the central tasks set by the Communist Party of the Soviet Union for enhancing the economic efficiency of production. The fur farms of the All Union Consumers' Cooperative Society have substantial resources, their proper utilization would ensure a significant improvement in the profitability level of fur production.

Scientific research on fur farming is being carried out in five laboratories and eight departments, these engage 25% of the workers of the Institute. The VNIIOZ has a large scientific-experimental fur farm, Vyatka, which is the base for experimental investigations and which recoups the entire expenditure of the Institute. The laboratories of the Institute are equipped with modern apparatus for carrying out the required analytical work. In many departments, the funds available for each scientist exceed 30,000 rubles.

Studies on the economics of fur farming have been considerably stepped up since the end of the last Five-Year Plan. Based on an analysis of the functioning of the fur farms and the state of feed resources in the Byelorussian Soviet Socialist Republic (Ryminskaya, 1972a, 1972b, 1974 and 1975), Kazakh Soviet Socialist Republic (Dobacheva, 1972 and 1975) and Krasnoyarsk region (Lineitseva, 1974 and 1975), recommendations have been made for specialization and for the quantum of the production targets up to 1980. Along with these recommendations, sufficient means of production and efficiency in their utilization by the fur farms should be taken into consideration. Advancements should be based on technological and scientific investigations.

On the fur farms of the consumers' cooperatives, a direct correlation has been established (Kolycheva, 1977) between the population density of animals and the profitability. When the herd strength of minks was 1,300 females, the cost of raising one kit was 41.9 rubles, while it was only 34.9 rubles on farms with an animal population exceeding 7,800 females. The profitability levels were correspondingly 12.8 and 30.1%. Such a pattern was noticed even on farms specializing in rearing blue and silver black foxes. Investigations are being carried out on investments and returns, and the

relationship between the availability of basic means and the profitability of production is being determined (Chirkov, 1972)

Work is being carried out in the laboratory for the planning of inventories and accounting procedures on the farms

The most significant proportion of funds is invested in the technology of breeding the animals. The use of these investment funds is hindered by certain factors associated with the biological characteristics of the fur-bearing animals. In the All-Union Consumers' Cooperative Society, half of the gross production of fur comes from farms in the southern republics, but the production potential of the animals under warm climatic conditions has not been fully realized. The main losses in production (Yazan, 1970a, 1970b, 1971a, 1971b, 1971c, 1972a, 1972b, 1972c, 1972d, 1972e, 1972f, 1973a, 1973b, 1974a, 1974b, 1974c, 1974d, 1974e, 1975a, 1975b, 1976a, and 1976b) occur during the rearing of kits. High temperature and direct sunlight reduce the growth rate of the kittens. Under the prolonged action of high temperatures, growth inhibition is inevitable. Increasing the number of times water is supplied to the animals for drinking and protecting the sheds from sun reduce the adverse effect of climatic factors.

One of the economically important problems of fur farming is the fattening of animals, which yields a greater advantage without any special or additional material, or physical expense. Investigations in this direction (Mamaeva, 1970, 1972a, 1972b, 1972c, 1972d, 1973a, 1973b, 1974a, 1974b, 1974c, 1974d, 1975a, 1975b, 1975c, 1976a, 1976b, and 1976c, Mamaeva et al., 1975, 1975a, and 1976, Zaitsev, 1975, Solomina, 1972, and 1973, Solomina and Yur'eva, 1975, and Yur'eva, 1975, and 1975a) have established that females of large size do not suffer from reduced fecundity, males are the main source of the hereditary characteristics relating to body size. On the Vyatka fur farm the average weight of the animals rose 50% by breeding and purposeful rearing of kittens over the last 10 years. In the gross output of the Vyatka farm the proportion of particularly large pelts exceeded 51%. The basic method by which the minks are grown to a large size is by selecting particularly large animals with good fur growth and with fertile parentage. In the final selection not only is there mating between uniformly large parents, but also between large males and females of moderate or even small size. The most constructive aspect of this method is the stimulation of the naturally high growth rate which is noticed in mink kittens up to the ages of 2.5-3 months.

Four years ago, work was started at the Institute on the farming of Kamchatka foxes. Breeding was based on hybridization of the Kamchatka fox with the silver-black fox, which multiplies well in captivity (Sokolov and Vokhmyanin, 1973, 1974, 1977a, and 1977b). Considering that the males are far less inhibited than the females in regard to their sexual behavior due to the cyclic nature of the sex phenomena, red males and silver-black

females were selected as mating partners. As a result of this cross breeding, some litters had only the characteristics of red foxes, others had intermediary features, with half of the litter being red and the other half gray. The breed was brought to the thoroughbred level by reciprocal crossing to F₁. During this work, the genetic diversity of the available silver-black fox population was identified and the existence of an Aleutian type established. Extensive data on genetics were obtained in a short period, but time is needed to process and interpret these data fully. In order to take up the breeding of Kamchatka foxes, high purchase prices are necessary.

In the last Five Year Plan period, two new colored varieties of coypu were evolved (Sokolov and Timofeev, 1970a, 1970b, 1971, 1972, 1973, 1974, and 1976). The genetic interrelationships have been established between these new varieties and those imported from abroad. These animals transmit the color of their fur strictly in accordance with Mendel's laws of dominance and recessiveness. Experience and the knowledge gained from the field of genetics have enabled commercial orders to be filled for the supply of coypu pelts in the desired colors.

One of the main tasks necessary for the qualitative base of fur breeding is to reduce infertility as well as the mortality of embryos and kittens. Various studies (Zaitsev, 1972, and 1975, Balash, 1974, and 1975, Balash and Chaimikova, 1976, and Sergeev, 1973, 1974, 1975, 1976a, 1976b, and 1976c) have pointed out the need for intensifying breeding work, perfecting the age composition of the herd and selecting pairs from parents with high fertility.

Based on embryological investigations (Kolpovskii, 1970, 1971, 1971a, 1971b, 1972, 1972a, 1972b, 1974, 1974a, 1975, 1975a, 1976, 1976a, 1976b, and 1976c), a new method has been developed to determine the age of embryos in animals which undergo embryonic diapause. In minks, the period of postimplantational growth has been established, the periods of embryogeny identified, and the hitherto unknown biological peculiarities of uterine and postnatal growth of mink kittens have been highlighted. By determining embryonic mortality using an indirect method based on the number of yellow bodies, it has been established that fetal loss is in the range of 50% in all stages of uterine development without exception. The fixed value of this index characterizes only the static part of this phenomenon and does not reflect the dynamism of the processes of growth and development. Determination of embryonic wastage by the direct method established that 20% of the embryos disintegrated after implantation, the maximum mortality being noticed in the stages of fetal hemopoiesis and the shifting from yolk nourishment to an allantoic mode of blood supply (placenta formation). The only method available at present for effectively reducing infertility is selective breeding aimed at forming parental pair combinations capable of fertile production.

Based on a study of the defects in the fur arising during the life of blue and silver-black foxes (Balash, 1971, 1971a, 1971b, 1971c, 1971d, 1972, 1972a, 1972b, 1972c, 1973, 1973a, 1974, 1975, 1975a, 1975b, 1975c, and 1975d), some causes have been identified and recommendations have been made which serve as prophylactic measures against such defects

Laboratory investigations on feeding are related to the study of the requirements of fur-bearing animals for nourishment and biologically active substances. Recommendations have been made for Ukrainian farms (Zaitsev, 1972, 1975, and 1976) on the optimum feeding norms for the mink, blue fox and silver-black fox. It is necessary to raise the caloric value of rations for lateborn kits by 15–20% over the prevailing norms. Based on laboratory and farm tests, it has been established (Isupov, 1977 and Isupov et al., 1975) that a 17–22% weight reduction in female minks before heat (estrous cycle) promoted the reproductive function. To reduce the fatness of minks, the feed level was reduced 27–35%, 2–2.5 months before the onset of the estrous cycle. In January–February, minks weighing over 1.4 kg were put on rations containing 160–170 kcal of metabolic energy. Rations containing 16.0–17.5 g of digestible protein meet the requirements of females. During the estrous cycle and gestation periods, the calorie content of the ration should conform to the prescribed norms. Gestating minks should each receive 21–22 g of digestible protein.

It has been established that it is possible to substitute the flesh of mussels for 30–56% of the meat and fish in the feed rations of juvenile minks. Moreover, it is beneficial to introduce *Azotobacter* bacteria into the food of fur-bearing animals (Yuzovitskiy, 1972, and 1972a).

A study of the metabolism of micro-elements in minks (Grakova, 1976, and 1977) demonstrated the deficiency of copper, manganese, zinc and iron in their feed. Additions of these elements to the rations had a favorable effect on the reproduction of females.

Researchers of the Red Banner of the Labor All-Union Research Institute of Animal Breeding (Ernst et al., 1975) carried out tests in which protein meal containing the larvae of house flies was substituted for the meat fish feeds. The meal can replace as much as 30% of the meat-fish feed in the ration of adult minks and 50% in the ration of juveniles. The addition of fly larvae meal to the ration did not adversely affect edibility, growth of the juveniles or pelt quality. Moreover, the test females entered the estrous cycle much earlier and more actively than the control animals.

Commercial studies on farm-bred furs are directed at improving the labor productivity of the breeders, lessening the work load during the slaughtering period and improving the quality of the pelts produced. In one market research laboratory, the utility of keeping the pelts frozen for temporary preservation was studied (Pirozhnik, 1975). It was established that this method, at a temperature of -10°C , did not impair the physical,

chemical or mechanical properties of pelts and did not complicate the technology for dressing them into semifinished products

To optimize the preliminary processing of pelts under farm conditions, rational regimes of drying and rolling have been worked out (Pestova, Sifonova, Sozinova and Shtogrina, 1976) Good results of preservation have been obtained in seven hours under conditions of constant air flow (1 m per sec) and relative humidity (40-50%) controlled by a three stage temperature regime The optimum conditions for rolling are temperature 40-45°C, relative humidity (absolute moisture) 30-40%, proportion of wood shavings 1:1, and duration 2 to 3 hr (for the pelts of females and males, respectively) The fat solvent is a mixture of ethylalcohol and aviation spirit in equal proportions, 10-20 g of the mixture is the norm per pelt

Market specialists have found an economical method for utilizing the pelts of dead young animals (Sudakov and Pestova, 1971, 1972, 1973, and 1974, Sudakov and Ignatov, 1975, Sudakov and Semakin, 1976, and Sudakov, 1977)

With their strength, heat insulation and commercial appearance, the pelts of dead animals are useful for making headwear, collars and frills for finished articles Special investigations are being carried out to prevent the burnt fat odor of the fur and to put the fat of fur animals to use (Pir-ozhnik, 1975) It has been established that the fat of fur-bearing animals consists of 20 different higher fatty acids Unsaturated fatty acids predominate in predatory animals, they are easily oxidized in the atmosphere to form products which decompose the fur tissue during storage Investigations have shown that the fat of fur bearing animals can be used as a raw material in the indigenous perfume industry Pharmacologists should take note of the long known and extensive use of the fat of wild fur bearing animals in popular medicine

The market research laboratory has developed a method to control the quality of fur produced on the consumer cooperative farms The causes of defects are being investigated

Laboratories dealing with diseases of fur bearing animals have been studying epizootiology and developing diagnostic methods for, and prophylactic measures, against several diseases, infectious and otherwise Work has been completed on developing a new chemically related vaccine against salmonellosis in fur bearing animals (Shereshkov, 1971, 1972, 1972a, 1972b, 1973, 1973a, 1973b, 1974, 1975, and 1976) This vaccine provides effective immunity after a single administration In a study on the causes of death among silver black and blue fox kittens in the first few days after birth (Stepenenko, 1971, 1972, 1973, 1974, and 1975), the pathogenic action of serotypes of *Escherichia coli* was established In order to protect the kittens from coli bacteriosis, immunogenic strains of *Escherichia* have been identified and experimental vaccines have been produced These are now being tested

in the field. In the work on developing a compound vaccine for animals (Polyakov, 1974, 1975, and 1976, Polyakov, Stepanenko and Egorov, 1975), encouraging results have been obtained in minks by simultaneous administration of vaccines against botulism and canine distemper. Studies on Aleutian disease (Vasil'eva, 1970, 1972, 1973, 1974, 1975, and 1976) have provided information on the transmission and spread of this disease.

During hepatitis, the etiological importance (Ryazantsev, 1972, 1973, 1974, 1976, and 1977) of the toxins of *E. coli*, *Staphylococci* perfusion, and toxic fungi, which adversely affect the fertility of females and the growth of the young, has been determined. Promising results have been obtained in efforts to reduce the infertility of fur bearing animals by the administration of biologically active preparations (Berdov, 1975, and 1976). Work is being carried out on perfecting the methods for pathological and anatomical diagnosis of diseases among fur bearing animals (Kaumov, 1975 and Sadvnikova, 1975, and 1976).

Researchers at the Institute have formulated recommendations for the control of listeriosis among fur bearing animals and Aleutian disease among minks, and for the diagnosis and prophylaxis of fat degeneration of the liver among minks.

In spite of the significant scientific research that was undertaken in the preceding Five Year Plan period, breeders and specialists have yet to find answers to many problems. Researchers at the All-Union Scientific Research Institute of Game Management and Fur Farming are implementing measures which will reduce the problems facing fur farmers.

MAIN STAGES IN THE DEVELOPMENT OF SOVIET FUR FARMING

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The 60th anniversary of the Great October Socialist Revolution, which has thoroughly transformed the political, economic and cultural life of our country, is approaching

In the past, many new branches of the national economy have been organized, including fur farming

Our country has long been famous for its furs. In Czarist Russia, however, the main supply of furs was through the hunting of fur-bearing animals. Only a few years before the October Revolution, some landowners began organizing small nurseries on their estates for red foxes, martens and other fur bearing animals. These diminutive nurseries did not, however, enjoy any commercial importance.

After the Revolution, animal-breeding farms began to be organized, right from the early years of restoration of the national economy. Since that time, the development of fur farming has proceeded so rapidly that our country is now first in the world in the production of farm bred furs.

The development of the Soviet fur farming industry, extending for over half a century, can be divided into a few stages. The *first stage*, which can be termed the preparatory stage, lasted up to 1928.

During this period, in different regions of the country, various organizations (State Fur Trading, Game Management Cooperatives, etc.) established the first small fur farms on which foxes of different colors, white and blue foxes, sables, martens and other fur bearing animals were raised. But these beginnings were not economical in view of the small number of animals raised (mostly red and white foxes), the insignificant size of the farms, the poorly developed production technology, the shortage of experienced workers, the ownership of farms by various organizations, and the absence of planned development for fur farming in the country.

The *second stage*, or the organized period, began in 1928. This was the period during which the first state fur farms were set up, pedigreed animal populations were reared, the methods for their rearing were mastered and the first batch of animal breeders was trained. The resolutions of the 15th congress of the party (December 1927) played a decisive role in the organization of the first of the large fur farms. These resolutions pointed to the need for a thorough reorganization of the country's agricultural sector, particularly for the organization of large, specialized farms.

The first state fur farms—Pushkinsk in Moscow and Tobol'sk in Western Siberia—were set up in 1928. By 1930, there were five state farms raising fur-bearing animals. The chief stocks raised on these ranches were the imported silver-black foxes. In 1928, these animals numbered 70 on all of the farms, by 1929 there were 304 and by 1930 there were 941. Moreover, at the end of 1930, the farms had 282 red foxes, 553 raccoon-dogs, 99 American minks and 171 sables. During these years, methods for rearing the animals were developed, a feed base for the breeding stock was organized, and the first fur farmers were trained. But the production of pelts by the state fur farms was still almost negligible during this period, since almost all the offspring went into increasing the breeding herd of the farms themselves.

The *third stage*, from 1930 to the beginning of the Great Patriotic War, was characterized by the rapid growth of the state fur farms and the development of fur farming on the cooperative farms.

The number of state fur farms rose and their capacity was also increased. The breeding of species which were found unprofitable was given up and all attention was turned to the breeding of silver-black foxes, blue foxes, minks, sables and coypus. The populations of these animals on the state fur farms increased rapidly (Table 1).

Table 1. The population increase of animals on the state fur farms, by year

Species	1931	1934	1940
Silver black fox	998	3 858	5 900
Mink	64	864	910
Sable	103	256	200
Blue fox	—	—	400

The actual population of the offspring rose significantly (from 2.1% in 1930 to 3.9% in 1940 per silver black fox). The methods of feeding and housing the animals were improved and the expenditure on their rearing was reduced. While in 1930 the state fur farms supplied to the state only a few dozen pelts of dead and killed animals, in 1940 they supplied 20,500 silver black fox pelts, 4,000 mink pelts, 1,500 blue fox pelts and 3,000 coypu pelts.

In the early '30s, the breeding of fur-bearing animals began on cooperative farms. Between 1934 and 1935, there were only a few cooperative farms in some districts raising fur-bearing animals. But by the beginning of 1941, 2,111 cooperative farms had been started in 31 districts, regions and republics. The number of fur-bearing animals was raised to a total of 12,400 silver-black foxes, 7,700 raccoon-dogs, 757 minks and 82 blue foxes. In 1940,

the cooperative farms supplied to the state 6,846 pelts of silver-black foxes, 7,896 of raccoon dogs and 807 of minks

The *fourth period* covers the years of the Great Patriotic War. Many state fur farms and collective fur farms began to appear in the territories temporarily captured by the enemy. A good many experienced fur farmers went to the front. The supply of feed, laboratories and construction material for the fur farms became complicated. As a result of all these factors, the animal population had to be temporarily reduced, preserving only the more valuable among them.

On the state fur farms, the population of blue and silver black foxes dropped by one-third and of minks by one half, between 1941 and 1945.

During the War the growth of collective fur farms stopped and many collective fur farms in several regions of the country were liquidated. On the surviving farms, the animal population dropped sharply everywhere, while the breeding of Ussurian raccoons ceased altogether due to their unprofitability.

Corresponding to the reduction in the animal population on fur farms during the War years, the output of fur products also decreased significantly. While the state fur ranches produced 20,500 silver black fox pelts, 4,000 mink pelts, and 1,500 blue fox pelts in 1940, the corresponding production in 1945 was 10,000, 1,200 and about 1,000 pelts. The output of the collective fur farms consisted exclusively of silver black fox pelts, which numbered only 10,000 in these years.

The *fifth period* covers the early postwar years, when the task was the rapid restoration of the branch of industry. It was necessary to reorganize the fur farms destroyed during the War, repair those surviving ones, restore and increase the animal population further and generate a new feed base for the fur farms, training cadres of young fur farmers was also looked into. These complex tasks were resolved in a short period (Table 2).

Table 2 The population increase of animals on the state fur farms in 1950 as compared to 1940

Species	Population		
	1940 in thousands	1950 in thousands	1950 to 1940 %
Silver black fox	5.9	15.8	267
Blue fox	0.4	2.6	650
Mink	0.9	13.4	1,483
Sable	0.2	0.8	400

In the early postwar years, there was also a rapid restoration and a further increase in the number of collective fur farms. By the early '50s the

animal population on the cooperative farms mainly silver-black foxes exceeded 20,000, i.e. almost reached the pre-War level

The restoration of fur farms enabled more farm-bred furs to be produced in 1947-1948 than in the pre-War years

The *sixth period* in the growth of fur farming in the Soviet Union (from 1950 up to 1960) may be called the period of thorough overhauling of the basic technology for rearing. In this period, on almost all of the farms, animals began to be housed in pens of smaller size instead of keeping them in single cells with earthen or wooden floors. The modern pens had a grid flooring raised above the ground, and were set in sheds of a standard type. This greatly reduced parasitic diseases among the animals, simplified the mechanization of production processes, reduced the area of the farm, improved the product quality, and reduced its cost.

Significant changes took place in the feeding of the animals, too. Formerly, the formulation of the ration and the feed standard of the animals were usually calculated on the basis of gross calorie content of the feed and its total protein content. In the postwar years, the feed began to be evaluated on the basis of total metabolic (assimilable) energy and digestible protein content. This greatly improved the feed of the animals and reduced its cost. At the same time, significant results were achieved in production processes for the preparation of the feed, in the utilization of new feeds and in the method of feeding the animals. All these factors promoted a rapid growth of the animal population (Table 3).

Table 3 Animal population by 1960 (in thousands)

Category of farm	Silver black fox	Blue fox	Mink	Sable	Coypu
State fur farms	50.9	36.0	266.0	About 2.0	3.3
Cooperative farms	45.0	12.0	3.2	—	—
Consumer cooperatives	49.6	20.0	30.5	—	15.2
Total	145.5	68.0	299.7	About 2.0	18.5

As before, the state farms played a leading role in fur farming during this period and the cooperative farms played an even greater role in this regard. Fur farming grew rapidly under the All Union Consumers' Cooperative Society.

The dynamics of fur production in this period can be seen in Table 4.

As can be seen from Table 4, the production of blue fox pelts (20 times greater) and coypu pelts (18 times greater) increased rapidly between 1950 and 1960. The increase in output was less for mink pelts (nearly nine times) and silver-black foxes (six times).

Table 4 Output of pelts of different species of animals raised from 1950 to 1960 (in thousands)

Year	Mink	Silver black fox	Blue fox	Coypu
1950	53.2	66.6	15.3	8.0
1960	462.6	421.5	314.9	144.1

The *seventh period* coincides with the years of the Seventh to the Ninth Five-Year Plans. For fur farming, this period was characterized by a rise in the number of farms in different regions of the USSR, their gradual strengthening, along with a high degree of specialization and better methods of rearing. The state fur farms and the farms of the All Union Consumers' Cooperative Society were the main breeders of fur-bearing animals in the country. The contribution of cooperative farms fell due to several economic factors. In some regions, individuals began raising fur-bearing animals (mainly coypu).

The rearing of minks, including colored minks, gained importance in animal breeding during these years. At the same time, the population of blue foxes increased while that of silver black foxes fell on the fur farms (Table 5).

Table 5 Population of females of different fur-bearing animals on all USSR ranches (in thousands)

Year	Mink	Silver black fox	Blue fox	Sable
1960	299.7	145.5	68.9	About 2
1975	2 176.6	97.4	159.9	5.7

The production of fur products also increased in these years (Table 6).

Table 6 Number of prepared pelts of different species of animals (in thousands)

Year	Mink	Silver black fox	Blue fox	Coypu
1960	462.6	421.5	314.9	144.1
1975	3 919.6	369.7	977.4	65.1

The overall cost of furs produced by the fur farms rose more than 10 times in these years.

During the Tenth Five-Year Plan period, the important tasks facing fur farmers as well as those in other branches of the domestic economy, are further improving finished products, and improving efficiency and quality. The Soviet fur farmers will spare no efforts in fulfilling this difficult but glorious task with honor.

ACHIEVEMENTS OF GENETICS IN BREEDING FUR-BEARING ANIMALS

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The basic principles of genetics are applied to a far greater extent in the breeding of fur-bearing animals than in the breeding of any other type of animal. Breeding work is based on the established principles of inheritance for a given characteristic. One of the main indices characterizing pelt quality is its color. Animals with many different color shades have been obtained through mutations. These colors are transmitted as simple alternative characteristics, which render their genetic analysis easy and enable the quality of progeny to be planned in advance by hybridization.

The genetics of fur bearing animals was first studied in the early 20th century, when the valuable silver black fox, which was in short supply, was mated with the red fox. The nature of inheritance of the black and red colors of the silver-black fox was then established. In the '30s, the genetic basis for the colors of hybrids and the northern Siberian gray fox was established in the Soviet Union.

In the field of genetics the quality was controlled following the start of massive breeding of colored minks. In the process of using mutations for breeding, the nature of inheritance of color was established, as it determined the method of rearing. Some mutations of minks produced in other countries were not discarded immediately, after trying them in the USSR. G. A. Kuznetsov established their genotypes. Thus, he found that the orchid-pastel mink carried, apart from the genes for pastel, the genes for orchid, forming a common allele with the gene of the American palomino, while the speckled mink represented a hybrid of the Headland gene and a hitherto unknown gene resulting in the appearance of a more spotted condition in the homozygous state.

The simple characteristic of the inheritance of the main colorations in accordance with Mendel's laws made it possible to obtain a significant number of color combinations, many of which became extremely popular (sapphire, vine red silver, etc.). By using two- and three-recessive colors, a greater percentage of four-recessives were obtained by mating minks which were heterozygous with respect to all of the genes.

The lethal effect of some color genes (platinum, white mordant and snow among silver-black foxes, dark and silver-sable among minks, golden coypus, and others) has modified the methods of breeding these animals. In order to maintain the litter size and obtain the same number of colored

offspring, they are not usually mated with those of a similar color, but with the standards

The interrelationships of genes identified in Soviet works have been applied to practical field work. The epistasis of the color genes of Headland minks over other color genes results in minks of all types, homozygous with respect to gene *h*, being invariably white, gene *z* acts as a darkener. Gene *z*, unlike gene Stewart, causes only a darkening of the color but not its alteration. Therefore, when mating *z* minks with poor, brown, standard minks, the undesirable color shades are retained and the resultant litters do not conform to the requirements expected from black minks. The interrelationships among certain other genes have also been studied. Thus, it has been demonstrated that heterozygosis with respect to the Aleutian color of silver-blue minks usually makes for the appearance of undesirable color shades, thus adversely affecting the pelt quality.

Apart from a study of mutant genes, which alter the basic color, the nature of inheritance of some color shades has also been lowered as a quantitative index. Thus, G. A. Kuznetsov and V. M. Il'in established that reddishness among minks was determined by polygenic recessive genes. This made it possible to recommend an effective method of obtaining 'pure' pelts by mating red females with males which don't have this defect. It was simultaneously demonstrated that 'pure' minks of the first generation obtained are heterozygous and that breeding, especially 'inbreeding', may yield a 'red' generation with different degrees of this defect.

While on the subject of pelt defects, it should be noted that G. A. Kuznetsov and G. M. Diveeva discarded the hereditary factors responsible for the thinning of hairs on the abdomen of minks, and this helped evolve measures for controlling this flaw. Data are available on the hereditary factors causing such diseases as 'dwarfism' among minks (Diveeva).

It is far more difficult to understand the nature of transmission of such quantitative characteristics as fur quality and fertility. Certain structural changes of the hairy cover, e.g., an increase in the hair length of sable and mink, are determined by a single gene. Thanks to this knowledge, it has become possible to obtain sable minks of different colors in a simple way. But longer or shorter length of hair in ordinary minks is caused by multiple genes. While selecting the parents for this factor, it should be remembered that the offspring produced by mating minks with different lengths of hair will not be totally homogeneous. Work has to be carried out over a few generations to obtain a homozygous color generation.

In studies on the inheritance of fertility, it has been established that the coefficient of transmission of this characteristic is very low, varying from 0.01-0.3. Relying on these data, no selection at all was made for this factor abroad as a result the average litter yield was very low. Regarding colored minks being imported to the USSR, many zoologists thought that the low

ucists explain this on the basis of the fact that the embryos of snow foxes homozygous with respect to the color genes perish in a very early pre implantation stage. As a result of this, there is a reduction in the death of implanted embryos usually noticed in foxes, specially in highly fertile females. Evidently, this would also explain the 25% or more reduction in litter sizes during the mating of white Azerbaijan coypus.

A study of the genetics of fur-bearing animals was undertaken, but the possibilities for its application have not yet been found. Studies of karyotype characteristics have established that the absence of a litter after mating American and European minks or Canadian and European beavers, which was explained as being due to differences in the periods of the estrous cycle or in the behavioral characteristics of the animals, and so on, was in fact related to significant differences in the chromosome numbers of these animals.

The data discussed above show how a knowledge of the principles of genetics is important in the breeding of fur bearing animals and how these principles can be used in production. Breeding on the basis of genetic principles would improve the quality of fur products of farm bred animals, which in turn would improve the economy of this industry.

fertility of these animals was due to the pleiotropic effect of mutant color genes. However, in the very first years of breeding colored minks in the USSR, it was demonstrated that color genes do not influence fertility: minks of the same origin, but with different colors (as a result of dissipation), had on an average, the same level of fertility, while minks of the same color but of different origins (for example, pure-bred colored minks and those obtained by segregation after mating with the standards) differed significantly in their fertility. It has been established that on transfusing the blood of standard minks, among which selection was made for fertility, this index increased in the offspring regardless of color. The conclusion was drawn that selection for fertility was possible and this was confirmed on the Soviet farms: where even *en masse* selection was made regularly, the litter size of colored minks was indistinguishable from that of the standard minks and sometimes the former recorded even higher indices.

A detailed analysis of the hereditary transmission of fertility showed that there were animals which quite regularly transmitted a low or high level of fertility to their offspring. Thus, selection of individuals may produce, and does produce, a clearly perceptible effect.

Soviet scientists established the hereditary factors responsible for sterility (though the nature of transmission of this characteristic is not yet adequately known). This enables the identification of animals whose entire litter should be processed for their pelts, since it is not possible to obtain any offspring from them. It has been found that the poor reproductivity of Headland minks is transmitted independently and is not associated with any physiological properties caused by the pleiotropic action of the genes of white color (*h*), as was regarded in other countries. By selecting only the young females normally yielding kittens, the Soviet breeders produced a herd of white minks, which in their reproductive capacity are in no way inferior to the standard ones.

However, the pleiotropic action of some color genes cannot be totally ignored. Thus, in spite of regular selection of the best animals, so far the longevity of kittens bearing Aleutian color genes, specially sapphire color, has been low. The works of A.I. Semchenko and Yu.A. Samkov have demonstrated the high protein needs of sapphire minks. A knowledge of these characteristics of certain genotypes of minks enables the breeders to feed them in such a way that the minks of each color shade are assured the best feeding indices.

D.K. Belyaev and his colleagues have been carrying out an extensive study on the effect of lethal genes. During the 'inbreeding' of platinum colored and white mordant foxes, the color genes of which have lethal action, a 25% reduction was noticed in the progeny. This agrees with the anticipated mortality of 25% of the homozygotes. During the 'inbreeding' of snow foxes (carrying the lethal gene) the cut yield was 25% less. Gene-

ticists explain this on the basis of the fact that the embryos of snow foxes homozygous with respect to the color genes perish in a very early pre-implantation stage. As a result of this, there is a reduction in the death of implanted embryos usually noticed in foxes, specially in highly fertile females. Evidently, this would also explain the 25% or more reduction in litter sizes during the mating of white Azerbaijan coypus.

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The data discussed above show how a knowledge of the principles of genetics is important in the breeding of fur-bearing animals and how these principles can be used in production. Breeding on the basis of genetic principles would improve the quality of fur products of farm-bred animals, which in turn would improve the economy of this industry.

SELECTION OF PEDIGREE LINES OF FUR-BEARING ANIMALS TO PRODUCE INTERLINE HYBRIDS

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Computers have been used in breeding work on nine state fur farms of the Leningrad interdistrict All-Russian Production and Scientific Combine for the Fur Farming Industry. This has enabled an assessment to be made of the useful hereditary characteristics of the entire animal population of the pedigree nucleus of minks, blue foxes and silver black foxes on all of the state fur farms in the combine (about 60,000 females and 15,000 males).

This has made it possible to select animals based on their hereditary characteristics from among pre-selected individual genealogical lineages, and to evolve commercial lineages of animals which would definitely transmit their superior qualities to their offspring.

Simultaneously along with improving the hereditary qualities of animals in a lineage the best possible combinations of lineages were identified with the object of reproducing them in subsequent breeding work. By selecting the most effective combinations from among the lineages, the animals in each succeeding generation of the lineages improved.

Thus, not only is selection made in the lineages, but there is a useful individual choice which opens up possibilities for systematically improving the genealogical lines in this manner and for producing commercial lineages with 4-8 branches, thus enabling interbreeding.

As determined during grading, the best lineages retain their high fur qualities for several years. It is far more difficult to ensure high efficiency of selection for the reproductive characteristics of fur-bearing animals. This compels us to find combinations of lineages which will ensure heterosis. Under certain three-line combinations of minks, the author obtained six or more kits from each female. The author explains this by the fact that heterosis of reproduction qualities is ensured, not only by a two-line combination of the female itself, but also by a combination of the third line representing the male line mating with the female.

AIMS OF SCIENTIFIC INVESTIGATIONS ON THE FEEDING OF FUR-BEARING ANIMALS

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1 The feed base for farm-bred, fur-bearing animals is now undergoing a thorough change. The use of meat byproducts and whole fish is being reduced while the use of marine products of little value to man—fish meal, edible yeast and vegetative protein feeds—is being increased. The need has arisen for studies to find new sources of protein for fur-bearing animals, keeping in mind their nutritional value and amino acid contents, and to determine their specific function and norms and the methods of their use.

2 The research institutes should first study thoroughly the edibility of krill, which is being collected on a large scale. It is important to study the methods and temperature ranges for storing this feed, the assimilatory nature of its nutrient content, its content of vitamins and minerals, especially microelements, the methods for preparing it as feed, its effect on the fertility and health of the animals, and so on.

3 Due to the results of studies on the edibility of fish meal and the methods for evaluating its quality, feeding the animals with dry, wholesome, rations will increase considerably in the near future. To introduce dry feed mixtures on a commercial scale, problems pertaining to their formation, the technology of granulation, methods for preservation and improvements in their taste qualities will have to be resolved. The availability of drinking water to the animals will have to be ensured throughout the year.

4 Research work carried out in recent years has confirmed the importance of standardizing the energy content of feed, as this is a factor determining the fertility of the animals. Further developments of scientifically based feed norms for the main herd and for the young, taking into consideration their weight, age, season of the year, and fertility, should ensure improvements in their reproductive capacity and in the quality of pelts. The new norms would enable an additional criterion to be introduced, i.e., feed input per unit of product output, in the evaluation of feeding efficiency.

Problems relating to feed standardization should be worked out in conformity with experimental work on the methods of feeding and the organization of herds, to fatten them by selection.

5 At present, most of the feeds given to fur-bearing animals have been studied for their amino acid composition. Analysis of feeds for their amino acid content has become quite common. The task before investigators is to establish the amino acid requirements of animals for body growth, develop-

ment of good pelts and reproduction Preliminary experiments in this direction show that a balanced diet in regard to amino acids would enable us to maintain quality pelts and yet reduce protein consumption by the animals by at least 20% compared with the recommended moderate feed norms and by 35-40% compared with the feed norms actually used at present on most of the farms

6 With a reduction in the meat fish feeds in the ration of these animals, their need for carbohydrates and fat increases

One task before scientists is to determine precisely the proportion of fat and carbohydrates in the rations, while correlating these to the needs of minks, blue foxes, silver-black foxes and sables of different age groups They must also evaluate the nutritional value of different types of grains and fats, the methods of preparing them for feeding and the fat stabilization, not only in relation to its influences on feed assimilability, but also to ensure the edibility of the feed mixture (taste qualities) and to maintain the animals in a healthy state

7 In the context of anticipated changes in the variety and nature of feeds for the animals, the formulations of retail vitamin preparations should be reviewed and the need for additives of micro-elements should be established Precise pre-mixes conforming to the new types of rations should be worked out

8 So far little work has been done on understanding the relationship between several widespread diseases and the feeding conditions

The role of feeding in the etiology of hepatosis, gall-bladder disease, underweight and hair shedding in minks, fraying of hairs in silver-black foxes, self-biting and endometritis in blue foxes and others, has not been studied

In order to reduce the extent of these defects and develop effective measures for controlling them, an extensive study of metabolism should be undertaken, using physiological, biochemical and other methods of investigation

9 Advancements in the laboratory methods used in biophysical and biochemical investigations lend hope that scientists working on breeding for fur will in the near future be able to study metabolism even in the early stages, and will be able to judge from the blood and urine indices the suitability of the feed ration for meeting the needs of the organism This would prevent diseases of the animals, and at the same time increase the efficiency of scientific investigations on the feeding of fur-bearing animals

ACHIEVEMENTS OF THE PHYSIOLOGY AND BIOCHEMISTRY OF FUR-BEARING ANIMALS

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A study of the physiology and biochemistry of fur-bearing animals is an important and urgent task facing Soviet scientists. Based on precise biological concepts and the characteristics of animals reared in captivity alone, it is possible to work out a better system for housing and feeding them, for breeding livestock, and for the diagnosis and treatment of diseases among these animals, which vary significantly from those of domestic animals.

The earlier work carried out by the author on the morphological aspects (erythrocytes, hemoglobin, leukocytes and differential blood count) and biochemical aspects (total protein and protein fractions, sugar, glycoproteins, total lipids, lipoproteins, cholesterol, potassium, sodium, calcium, phosphorus, magnesium, iron contents and precipitation reactions) of the blood compositions of the main types of farm-bred, fur-bearing animals, such as minks, blue foxes and silver-black foxes, has been presented in the monograph 'Physiology and Biochemistry of the Blood of Fur-Bearing Animals' (Petrozavodsk, 1971). This monograph is widely known to fur farmers.

In recent years, in the physiology laboratory for fur-bearing animals in the Karelian Division of the Academy of Sciences of the USSR, much work has been done on the physiology of immunity, on enzymatic activity of blood serum and vitamin metabolism, and on the pathogenicity of several infectious, epidemic and non infectious diseases of fur-bearing animals.

Work in the field of physiology of immunity included a study on cellular factors (phagocytosis) and humoral factors (complement, lysozyme and beta-lysin) in natural resistance.

The investigations of L B Uzenbaeva established that the phagocytic reaction among fur-bearing animals, as in other animals, proceeds in stages and is characterized by a phase during which the phagocyte approaches the foreign particle, and the phases of attraction, absorption and disintegration of micro-organisms. Particular attention has been paid to an analysis of the processes of intracellular absorption and destruction which represent a natural continuation of the preceding phase of phagocytosis. The efficiency of intracellular digestion can be judged from the degree of the intracellular absorption and disintegration processes.

In vitro experiments have demonstrated that phagocytic activity is not the same in different species of fur-bearing animals, but depends on sex and physiological state, and to a significant extent on age.

For example, the clearly manifested activity ($47.39 \pm 2.64\%$) and absorption intensity ($2.21 \pm 0.12\%$), and intracellular disintegration ($30.89 \pm 2.15\%$), in 40-day-old blue foxes were perceptibly activated in the three-, four- and five-month cub stage, reaching in the five-month-olds 67.8 ± 5.27 , 5.68 ± 0.6 and $48.50 \pm 3.3\%$, respectively. In blue foxes aged six months, a reduction in the number of leukocytes in the absorption stage ($50.71 \pm 3.02\%$) and an increase in phagocytic reaction ($31.50 \pm 3.58\%$) were noticed. The latter was accompanied by an even lower level of absorption capacity ($2.89 \pm 0.17\%$).

In mature fur-bearing animals, the maximum possible degrees of the variations of indices were determined for phagocytosis in different seasons of the year (spring, summer, autumn and winter) and their mean annual levels were calculated. Further, the variation range throughout the year as well as the mean annual level of leukocytes participating in absorption ($48.46 \pm 1.42\%$) and intracellular digestion of bacteria ($22.26 \pm 1.69\%$), and also the loading of phagocytes by microbes (4.37 ± 0.26), differed from the levels noticed in minks (37.54 ± 1.54 , 35.14 ± 2.50 and $2.14 \pm 0.10\%$, respectively). It is significant that the absolute number of mature neutrophils in the blood of the above species of animals also changed in the course of the year and averaged 2.35 ± 0.12 thousand in blue foxes and 3.03 ± 0.20 thousand in minks.

As far as the seasonal dynamics of phagocytic activity are concerned, there was a definite similarity between minks and blue foxes in the direction of the changes in phagocytosis indices, especially in the phagocytic number (number of microbes absorbed by a single phagocyte) and the absolute values of phagocytosis. On the whole, a fairly high level of phagocytic activity in the spring was characteristic for both minks and blue foxes. This was particularly apparent on converting the relative indices of phagocytosis into absolute values.

From among the humoral factors, the natural resistance of complementary factors, lysozyme and beta-lysine, was studied. It has been established that all these indices show age and seasonal variations.

In all of the mink genotypes studied (standard, white, silver-blue and sapphire), the level of complement decreased with age (in the standard animals from 37.6 ± 0.7 units in two-month-old kits to 26.2 ± 0.8 units in five-month-old kits and 23.1 ± 0.6 units in the adults).

Serum lysozyme was characterized by a high level of activity even in the two-month-old kits (8.5–11.3%). In standard minks in the subsequent two months, this activity increased to 11.0%, after which it again decreased to the original level. In colored animals, its activity gradually decreased to 8%.

The activity of beta-lysines in standard minks varied from 35.9 to 45.6%, one exception being four-month-olds in which this level decreased to 17.1

$\pm 1.2\%$ In colored minks, their range was 28.1 to 42.8%, with the maximum values being seen in the two-, five- and six-month olds and the minimum in four month-olds and adults

Seasonal variations in complement activity were characterized by its comparatively low level in winter (18.3 ± 0.3 units in the standards) and autumn (18.4 ± 0.4), and a rise in spring (23.9 ± 0.7) and specially in summer (28.4 ± 1.0 units)

The dynamics of seasonal variations in lysozyme activity were analogous in all three genotypes of colored minks the maximum lytic activity of serum was seen in winter, it decreased sharply in spring, a fresh rise was seen in summer followed by a decrease later in autumn In standard minks, the lysozyme level was high in winter and spring (9.7 ± 0.3 and $10.0 \pm 0.3\%$) and decreased by autumn (to $7.0 \pm 0.1\%$)

The activity of beta lysines in standard minks remained at the same level in winter ($34.0 \pm 1.2\%$), spring ($34.7 \pm 1.5\%$), and summer ($31.2 \pm 1.9\%$), and increased substantially in autumn ($45.3 \pm 1.2\%$) In colored minks, the highest activity of beta-lysines was in spring, decreasing in summer and again rising in winter (Mel'nik and Malinina)

In blue foxes, unlike in minks, there was a gradual increase in the indices of natural immunity with age In 40-day-old litters, the properties of serum complement were not seen and lysozyme and beta-lysine recorded the least activity ($4.4 \pm 0.8\%$ and $15.2 \pm 1.9\%$, respectively) In two-month-olds, complement was detected in some of the animals (in 12% of the cases) while it was detected in all of the three month-olds tested (average 9.4 ± 0.2 units) Later, the activity of humoral factors of immunity increased and reached a maximum in the four-month olds with respect to lysozyme ($6.5 \pm 0.1\%$), five-month olds with respect to beta-lysine ($40.6 \pm 2.8\%$) and in the adult blue foxes with respect to the complement (12.5 ± 0.4 units)

The seasonal dynamics of the indices of natural immunity in adult blue foxes were reflected in a very high complement activity in winter (12.9 ± 1.1 units) and summer (14.3 ± 0.6 units) compared with the spring (10.3 ± 0.5 units) and autumn (10.4 ± 0.4 units). They were also reflected in a rise in the level of beta-lysine activity in spring ($54.6 \pm 1.4\%$) and a reduction in it in summer ($13.5 \pm 1.0\%$), its content remaining stable in autumn and winter (28.4 and 26.3%), and in a relatively constant lysozyme activity throughout the year (5.5 to 5.8 %; Mel'nik)

The established antiphases of the seasonal variations of cellular and humoral factors in minks and blue foxes point to the presence of compensatory reactions aimed at supporting the reactive state of the organism through more effective protection mechanisms under the given conditions

Moreover, the fairly high variability in the activity of individual indices may suggest the presence of animals in a herd with different levels of resistance This provides a promising method for isolating highly resistant groups of

animals, by selection and hand-picking on the basis of the above characteristics

Preliminary data have been obtained on the influence of some pathological states (dystrophy, anemia, hepatosis virus plasmocytosis, diphyllobothriasis and toxascaridosis) on the natural resistance of the organism. This makes possible an even deeper study of the pathogenicity of the above diseases among fur-bearing animals.

Colleagues in the laboratory have obtained extensive data on the normal enzymatic status of the blood of fur-bearing animals, as well as its status under the different pathological conditions, after parenteral administration of protein hydrolysates and after the addition of biologically active substances to the ration.

It has been found that the age wise dynamics of the enzymes of carbohydrate and protein metabolism proceed in the same direction in blue foxes and minks of different genotypes. Changes in the activity of lactate dehydrogenase (LDG) and amylases were characterized by a two-phase curve with a maxima in two- and five-month olds and with the maxima at two and six months for transaminase. It has been established that the serum enzymes of carbohydrate metabolism as well as aspartate aminotransferase (ASAT) increase with age, while alanine aminotransferase (ALAT) decreases.

Seasonal variations in the enzyme activity of minks and blue foxes were manifested in an intensification of transamination processes and a drop in the activity of LDG and amylases in summer and the converse in winter.

The absolute values for the activity of the enzymes under study in blue foxes and minks during all their life periods differed sharply. LDG and transaminases (TA) (total) were invariably higher in minks (13.21 ± 2.18 M of pyruvate and 115.78 units of TA against 11.14 ± 0.53 M and 92.68 units in blue foxes) while amylase was higher in blue foxes (1.99 ± 0.07 against 0.70 ± 0.18 mg of starch in minks).

Differences in enzyme activity depending on the color of animals were noticed only in some growth periods (two and five to six months) or in some periods (in February and July). The mean annual values for the activity of enzymes in emerald, silver-blue and pastel minks did not differ significantly from the level noticed in standard animals.

Determination of the activity of serum enzymes under different pathological conditions showed that during spontaneous (alimentary) anemia and lactation breakdown in minks, the LDG level rose from 13.21 to 20.5 M of pyruvate, ASAT and ALAT rose from 90 to 120 units, and ALAT from 29 to 60 units.

The hyperenzymatic activity noticed in sick animals totally disappeared after a course of treatment with L 103 hydrolysine.

The level of enzyme activity was stimulated by the addition to the feed ration of preparations containing chlorophyll derivatives. This is particularly

marked in white minks, but it reduced the LDG activity as well as the transition of their metabolism into a more effective aerobic course of energy production.

A considerable amount of work has been carried out in determining vitamin concentrations in the organs of fur-bearing animals. One gram of mink liver under Karelian conditions contained $2,860 \pm 363$ IU (March) to $5,214 \pm 189$ IU (November) vitamin A, 0.190 ± 0.02 to 0.208 ± 0.004 mg% vitamin C, 0.036 ± 0.002 mg% vitamin B₁ and 1.62 ± 0.06 mg% vitamin B₂.

In the liver of blue foxes there were $1,793 \pm 110$ IU vitamin A, 0.150 ± 0.007 mg% vitamin E, 0.062 ± 0.006 mg% vitamin B₁ and 1.736 ± 0.05 mg% vitamin B₂.

The influence of biologically active additives produced from green plants (provitamin concentrate, chlorophyll-carotene paste and aspen fat) on the physiological state of minks was established (Petrova, et al.).

E.P. Gulyaeva completed an extensive study on the physiology of respiratory and cardiovascular systems.

Among investigations on the physiology and biochemistry of fur-bearing animals carried out by other research groups, mention should be made of the works of Ya.Z. Lebengarts. He collected data on the amino acid composition of blood, on the activity of some enzymes and on the protein pattern of blood and its morphological composition, mainly among colored minks.

V.I. Astrakhansev and G.S. Taranov published the results of their studies on enterokinases and intestinal alkali phosphatases in minks and sables.

Notwithstanding the positive results of studies on the physiology and biochemistry of fur-bearing animals, there is, primarily, an almost total absence of investigations on the physiology of digestion and on higher nervous activity, while the studies on biochemistry are so far clearly inadequate.

EPIZOOTIOLOGICAL STATE AND PROBLEMS OF VETERINARY SCIENCE IN FUR FARMING

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Until 1973, canine distemper caused the deaths of tens of thousands of farm bred, fur-bearing animals, resulting in huge economic losses to the fur farming industry, however, it has now become rare and is almost unknown on the state fur farms of the All Russian Production and Scientific Cooperatives of the Fur Farming Industry in the Russian Soviet Federative Socialist Republic. This has been made possible in our country by the use of three highly immunogenetic vaccines against canine distemper 668KF, Vakchum and EPM. These are sold by biological factories and institutes in sufficient quantities. Almost all fur-bearing animals are given prophylactic doses of vaccine against this disease. Moreover, the institute also uses the imported vaccine ASL (USA).

Viral enteritis is widespread among minks in the Soviet Union and has been registered on all of the farms in the Far East, and on some farms in Siberia, Karelia and Byelorussia. On the state fur farms of Sakhalin alone, about 11% of the kittens perish from this disease, which represents a great loss to the fur farms (valued at several million rubles).

Up to 1973, this disease tended to decline, but it was reported from new sites which had not been considered prone to viral enteritis among minks. Starting in 1975, several farms began being registered afresh in Tatania, Karelia, Byelorussia and other places. The vaccine against viral enteritis among minks serves to control this disease and is also used for its prophylaxis. Initially, an imported vaccine was used. At present, the NIIPZK prepares this vaccine in a culture of the renal cells of kittens, as well as an associated vaccine against two diseases—viral enteritis and botulism among minks. In the current year over two million doses of the associated vaccine will be released for prophylactic administration to all minks which were hitherto not prone to viral enteritis.

The vaccine used for prophylactic purpose provides prolonged and reliable immunity. Instances of loss of immunity have not been reported. The vaccine may also be used during enzootic states, the disease then ceases within 12 days after administering the vaccine.

Fur farms which are prone to viral enteritis will have to follow strictly the instructions for combating this disease: not marketing minks for some years, vaccinating the kitten and adult minks annually, isolating from the herd the animals which have suffered from viral enteritis, and regular

disinfection of pens and the entire area of the fur farm

Pseudomonas poses a serious danger to mink breeders. While until 1975, it was registered on one or two farms every year, it was recorded on 20 farms in the Far East and Siberia in 1975 as a result of the poor quality of feed. Almost all of the state farms in the Far East and the Sakhalin Cooperatives were affected by this disease. Because of the shortage of vaccine, the state fur farms suffered colossal losses. Over 10,000 minks died on the Slavyansk state farm alone. The position was no better in 1976. The Armavirsk biochemical factory was urged to produce anti pseudomonas vaccine and succeeded in supplying it to all of the state fur farms in the Far East and Siberia, and pseudomonas declined on these farms.

However, unexpectedly, this disease arose on four state fur farms in Karelia, on two Tatar farms and in the southern and western regions of the Russian Soviet Federative Socialist Republic.

In 1976, cases of pseudomonas were registered on 12 farms which had formerly been free of the disease. The only method of prophylaxis and control of this disease is anti pseudomonas vaccine. The antibiotics and other chemotherapeutic drugs used until then did not produce the expected results, even though the blue pus bacillus, the agent of pseudomonas *in vitro*, is sensitive to some antibiotics (polymixin M, streptomycin and others).

Minks on farms formerly prone to pseudomonas should be vaccinated in mid-August. Under enzootic conditions, the vaccine should be used as quickly as possible and deaths cease 5 or 6 days after vaccination. But even then much damage is caused on the farm. Pseudomonas is a contagious disease, the incubation period of which lasts 18-20 hours. Within the five or six days before immunity is effective (on vaccination), a large number of animals die. At the time of vaccination the animals are caught in nets. The mittens used for this should be disinfected with a 1% solution of formalin. This should be carried out in accordance with the instructions given in GUV MSKh SSSR (Central Board of Vaccines, Ministry of Agriculture, USSR) on May 5, 1976.

In recent years, encephalopathy has been encountered with increasing frequency among minks. Every year new locations are affected by this disease. It has a prolonged incubation period (up to 7-8 months or more), and adult minks are the most susceptible. It can attack up to 80% of the main herd of animals. At present, in the cooperative system of farms in the Russian Soviet Federative Socialist Republic, there are four areas prone to this disease.

The sources of infection of encephalopathy and the biological characteristics of the virus should be studied, and measures to control it should be developed.

The etiology of self biting among sables has not been studied. Scientists

at the Siberian Veterinary Research Institute (Martynov, Zhdanova, et al) believe that self-biting among sables is caused by a neurotropic virus. Veterinarians at the Pushkinsk state fur farm (Slugin and Paranych) feel that stress phenomena are the root cause of this disease. According to the author, self-biting is caused by a virus as well as by stress phenomena.

Ringworm poses a great danger to silver-black and blue foxes. In recent years, there have been instances of its occurrence on the state fur farms. At present, the Institute of Fur Farming and Rabbit Breeding, along with the All-Union Order of Lenin Institute of Experimental Veterinary Sciences, is working to develop measures for controlling this disease.

One of the infectious diseases occurring in blue and silver-black foxes is colibacteriosis, which has become widespread in recent years.

Investigations carried out at our Institute (E. T. Tsvetkova) have established a large number of O-serotypes of *Escherichia coli*, which cause colibacteriosis among blue fox cubs. Further, every year, on any given fur farm, they alternate or supplement each other which makes it difficult to develop a vaccine or specific prophylactic measures for colibacteriosis in fur bearing animals.

A vaccine has been developed at the Institute of Fur Farming and Rabbit Breeding for the prophylaxis of viral hepatitis among blue and silver-black foxes (author V. A. Chizhov). This has been used successfully on fur farms.

Aujeszky's disease causes immense harm to all species of carnivores. The nucleus of infection enters the farm with pork byproducts. The disease may cause the death of 5-6% of the animals at any time of the year. These byproducts are isolated and boiled on the fur farm as a prophylactic measure against this disease. Therefore, the development of methods to be used specifically for prophylaxis against Aujeszky's disease among fur bearing animals is of great importance.

Two vaccines are now being developed for prophylaxis against this disease (All-Union Research Institute of Veterinary Virology and Microbiology and Armenian Research Institute of Animal Breeding and Veterinary Science), and these have undergone tests at our Institute. As a result of these experiments, it has been established that the vaccine of the Armenian Institute, when administered twice at three-month intervals, protects 81.5% of the vaccinated minks from infection by the 35LD/50 virus of Aujeszky's disease. The other vaccine is somewhat weak. It is therefore better to use the Armenian Institute's vaccine as a prophylactic measure against Aujeszky's disease among fur bearing animals.

Attention should be drawn to the work of V. S. Slugin for determining the specific antigen to diagnose Aleutian disease among minks.

The development and use of aerosol vaccination methods against canine distemper, viral hepatitis and other diseases of fur-bearing animals should

be regarded as urgent tasks for the veterinary scientists concerned with fur-bearing animals.

In order to decrease the workload of field veterinary personnel and improve their output, associated vaccines against two or three infectious diseases should be developed for use on fur-bearing animals. Measures for the control and prophylaxis of gall-bladder disease and under-wetting among minks and diseases affecting their hair should be developed, as well as methods for disinfection under conditions of different types of infectious diseases among fur-bearing animals.

Biology and Breeding of Fur-bearing Animals

VARIATIONS IN THE THYROID FUNCTION OF COYPUS AND MUSKRATS

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The endocrine glands, particularly the thyroid, play an important role in the complex process of regulating all development which occurs under the control of the nervous system. The hormones secreted by the thyroid take part in all of the growth processes of the organism. Because of the inadequate attention paid to this subject, investigations were carried out on the functional state of the thyroid gland and on the weight indices of the body and certain internal organs among coypus and muskrats, taking into consideration their age and sex.

Investigations showed that the functional activity of the thyroid gland was much greater in a growing organism than in an adult. For example, the absorption of radioactive iodine-131 by this gland was 50-80% more in 3- to 5-month-old animals than in the adults (20-24-month-old animals), and the formation of the iodine-containing hormone and its discharge into circulation were 15-25% more. The intensity of its activity gradually decreased with age, specially in old animals. The thyroid gland in females was characterized by greater activity than that in males, especially during the periods of fertilization, gestation and lactation. Moreover, different stages of development were characterized by typical growth tempos in the cubs. Growth intensity was far greater in the initial stage of postnatal growth and lower in subsequent periods. Sex-wise differences were also noticed, a range of variations began to be perceptible roughly after the age of one month.

Sexual dimorphism was also noticed in the indices of body weight and weight of certain internal organs. Thus, the body weight of males was 6-12% more than that of females. The thyroid index was 28.4% in male coypus and 32.2% in females. These values were 10.3 and 12.1%, respectively, in muskrats. The heart index was 4.1 per thousand in male coypus and 3.3 per thousand in females, in muskrats it was 4.6 and 3.8 per thousand, respectively. The spleen index was 1.3 per thousand in male coypus and 1.1 per thousand in females and in muskrats it was 1.2 and 0.9 per thousand, respectively. The kidney index was 7.9 per thousand in male coypus and 7.6 per thousand in females, and in muskrats it was 8.1 and 7.6 per thousand, respectively. The liver index was 45.0 per thousand in male coypus and 40.0 per thousand in females and in muskrats it was 41.0 and 39.0 per

thousand, respectively.

Thus, different developmental periods are characterized by typical functional variations in the thyroid gland. As an individual grows, these changes are accompanied by changes in the body weight and the relative weight of internal organs. Further, sex-wise differences persist in the functional activity of the thyroid gland, as well as in the weight indices of some internal organs.

ANIMAL GROWTH CURVE CONSTANTS

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Characteristics of the growth process in farm-bred, fur-bearing animals are important in breeding work. The set of growth constants of I I Shmal'-gauzen is often used when comparing the growth of animals. According to him, the growth curve of an organism consists of individual sections of 'natural growth periods', each of which is characterized by its own growth constant, which is constant in that growth section and is calculated according to the formula

$$K = C_w \times t = \frac{\log W_2 - \log W_1}{0.4343 (t_2 - t_1)} \times \frac{t_2 + t_1}{2}, \quad (1)$$

where W is the weight of the animal, t is the time and C_w is the specific growth rate

Experimental data on growth curves show that sections (periods) of growth can actually be isolated and the growth of animals in these sections can be compared. However, this method of comparing the growth sections needs to be made more precise.

The value of K calculated using equation (1) remains constant when the value of t changes only in the first growth section [growth in the form of a parabola starting at the beginning of the coordinate $W = a_0 t^{K_1}$ (2)]. In this section, K roughly corresponds to the constant K_1 . In the other growth sections, K often varies quite widely. Usually, the average values of K are calculated for these sections. However, the average values of K for two groups of animals can be the same in a section, but the growth curves in that section may vary.

It should further be emphasized that the value of the constant alone does not determine the growth curve, even in the first growth period. The growth curves of two groups of animals may have identical constants K_1 in equation (2) but different constants a_0 . These would then represent two different curves with different growth tempos. Similarly, in the other growth sections the growth curve cannot be conclusively described by any one constant. How then do we compare the experimental growth curves in different sections? For this purpose, some methods of statistical approximation (for example, MNK) should be used to select in a section one of the simple equations, i.e., direct, exponential, parabola of general form, etc., for the experimental points. Then, the differences in the values of a given

parameter in two groups of animals can be confirmed by testing the statistical significance of the difference. The main growth characteristics in different sections (growth rate, specific growth rate, etc.) can be easily found if the growth curve equations in these sections are known.

STUDIES ON THE PHRENIC NERVE IN MINK

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The phrenic nerve exerts an influence on the tension of the diaphragm, pulmonary capillary circulation and lymph circulation. Many investigations have been carried out on the form and structure of this nerve in man, cattle and other domestic animals. But works on this nerve in fur-bearing animals are few (Slesarenko, 1971, and 1972, Sorkin, 1971, and Uzhegov, 1973).

The author studied the formation of the phrenic nerve, its course and range in 14 mink carcasses using the method of Acad. V. P. Varobev. This study established that the ventral branches of the fifth to seventh pairs of cervical spinal nerves essentially take part in the formation of the phrenic nerves. The branch of C_5 turns caudo ventrally, and joins the branches of C_7 and of the brachial plexus. At the level of the first rib the phrenic nerve unites with the stellate ganglion, vagus, and first intercostal nerves. The left phrenic nerve runs ventrally to the gullet, while the right one runs along the dorsal region of the caudal field of the vein between the right lung and its accessory lobes. During this course, both nerves set out tiny branches to the lung pleurae and enter the diaphragm where each one is divided into three tiny branches: ventral, median and dorsal. Instances have been noticed in which the phrenic nerve divides before entrance to the diaphragm. The nerve branchings are mostly of a primary type. Of 28 cases studied, 24 were branched primarily and only in four cases was the division scattered. Furthermore, in all four cases the type of branching of the right and left nerves was not the same. In any type of branching, the median, main branch is always thicker and serves somewhat like a continuation of the main trunk. Its direction is invariably caudal with a deviation to the lateral or median direction. The dorsal right branch, after perforating the diaphragm into the abdominal cavity, anastomoses along with the solar plexus. The dorsal left branch is much thinner. The main trunks are divided into second order branches in the muscular portion of the diaphragm. The main mass of second order branches penetrates the abdominal surface of the diaphragm and diverges radially in all directions. The third order branches formed from the second order branches are divided into very tiny fourth order branches anastomosing among themselves and forming a nervous network.

The much larger branches (second and third orders) are very often located on the diaphragm surface while the smaller ones enter the inner portion of the diaphragm. Visible contacts between the phrenic nerve and the liver have not been detected.

Conclusions

1. The phrenic nerve in minks is formed by the branches of the fifth to the seventh pairs of cervical nerves and branches of the brachial plexus.
2. The phrenic nerve gives thin branches to the gullet, vagus, stellate ganglion, pericardium, pleurae, intercostal nerve and solar plexus.
3. In the diaphragm, the nerve is divided into three main trunks (ventral, median and dorsal). The predominant type of nerve branching is arterial.

RELATIONSHIP BETWEEN THE REPRODUCTION RATE OF YOUNG FEMALE SILVER-BLACK FOXES AND THE PERIOD OF THEIR BIRTH

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On most fur farms, young foxes are selected from early litters for breeding purposes. According to standing instructions, young silver-black foxes born after April 20 and blue foxes born after May 20 are not recommended for this purpose. This recommendation is based on the fact that late-born ones grow and develop poorly, because of unfavorable climatic conditions (high summer temperatures). As a result these animals do not reach sexual maturity in the first reproduction season or mate at the end of heat. Such a selection, according to the prevailing views in fur farming, leads to early mating and hence to early littering.

The selection of young from early litters for use in breeding is often made without taking into consideration the climatic zone. As a result, in northern regions and sometimes in central regions of the Soviet Union, large wastage of young silver-black foxes is noticed during the periods of littering and early lactation due to frost bite and catarrhal diseases. In the south, on the other hand, early litters find themselves in the most favorable temperature conditions. Therefore, the selection of young silver-black foxes for breeding on the basis of their birth periods should be made taking into consideration the climatic zone in which the farm is situated.

It should be noted that raising young born in the middle and late periods is economically more profitable than raising animals born early. This is because the maturity of the hair coat and hence the killing of foxes born at different periods takes place at roughly the same time. Taking the average cost of feed per day on the consumer cooperative farms as 25-30 kopeks, the difference in the cost of raising cubs born in the early period compared to those born in the middle and late periods would be 2-3 and 5-6 rubles, or 2,000-6,000 rubles for a herd of 1,000 animals.

In order to establish the relationship between the reproductive capacities of young female silver-black foxes and the period of their birth, zoological data from 1970 to 1976 for fur farms in Vyatka (Kirov region) and Kretingisk (Lithuanian Soviet Socialist Republic) were analyzed.

As a result of these investigations, it has been established that the kitten yield and the fertility of young female silver-black foxes born in March or early April did not differ significantly ($P < 0.95$) from the corresponding

indices for females born at the end of April or early May. Thus, breeding stock can consist of animals irrespective of the period of their birth. Only their growth and development need to be cared for.

MAIN CAUSES FOR STERILITY AMONG FEMALE SILVER-BLACK FOXES

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Losses due to sterility among female silver black foxes on fur farms are significant. On farms of the consumer cooperatives, the number of sterile females varies from 10 to 13% in different years. As a result, these cooperatives lose about 20 000 cubs annually. At the prevailing average realization prices, the industry loses fur costing over 1.5 million rubles a year. The control of sterility among females is thus of vital importance for increasing the yield of cubs and, in the ultimate analysis, for enhancing the profitability of fox breeding.

The object of the present investigation is to establish the main factors responsible for sterility among female silver black foxes. The relationship between the sterility of females and their age, mating periods, intervals between mating and the litter size from which the mothers came, were established from data of the Kretingsk fur farm (Lithuanian Soviet Socialist Republic) and the Vyatka (Kirov region) fur farm. In 1975, a special experiment was carried out on the Vyatka fur farm to establish the possibility of obtaining offspring from sterile females. The following conclusions have been established on the basis of these studies.

The maximum incidence of sterility is among female silver black foxes mating at the beginning or end of heat. Among female mating once, the number of sterile ones is significantly more than among females which have mated with the same male on the second or the third day after the first mating. The maximum percentage of sterile females is seen among young animals.

The fertility of females in the year following the sterile year shows no significant difference from that of their sisters which littered normally every year. Sterility is encountered more often ($P > 0.99$) among females coming from small litters (three or four litters), than among females coming from large litters (six to eight cubs).

EFFECT OF SOME FACTORS ON THE BREEDING CAPACITY OF CAPTIVE BLUE FOXES

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One of the main factors affecting the profitability of blue fox farming is their breeding ability, which in turn depends on the feeding, living conditions, pedigree level, period of mating of females and their subsequent mating, number of matings, age, and other factors

There are different opinions in literature regarding the influence of the mating system on fertility among blue vixen. According to the data of I D Starkov (1940) and E D Il'ina (1952), an increase in the number of matings promotes increased female fertility. According to the data given by E V Ivanter (1971), however, increasing the number of matings does not indicate increased fertility, but only a reduction in the number of sterile females.

The author therefore carried out an investigation on the Vyatka fur farm in the Kirov region to study the reproduction rate of blue vixen in relation to their age and mating system. The following conclusions emerged from this investigation.

The reproductive capacity of blue vixen is highest at the age of two to five years. Best litter sizes are recorded by the females mating between March 1 and 30. Females mating after March 30 yield very poor litters ($P > 0.99$). The yield from females mating two or three times with the same male is higher ($P > 0.99$) than from females mating only once. The litter size is directly proportional to the period of matings of the females. Best results are recorded by the second mating of females on the day following the first mating. Then, the yield of kittens is higher ($P > 0.99$) than on their mating two or three days or more later.

EFFECT OF GONADOTROPIC HORMONES ON THE REPRODUCTIVE FUNCTION OF BLUE FOXES

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At present, various biologically active substances are widely used to enhance the fertility of farm animals. In animal breeding hormonal preparations such as the serum and blood of pregnant mares, gonadotropic hormones and others, are used. Gonadotropic hormones stimulate the functioning of the gonads, cause the formation of additional follicles and stimulate the stages of the estrous cycle in some forms of sterility. Much success has been achieved in recent years in animal breeding, especially in the breeding of pigs and sheep.

Unfortunately, so far, there is little information regarding the influence of such preparations on the reproductive rate of fur-bearing animals. It has therefore been resolved to study the effect of gonadotropic hormones on the reproductive function of fur bearing animals.

The experimental work was carried out on the Vyatka fur farm. In order to determine the effect of the hormone on blue foxes, and the effectiveness of different doses of the preparation, five groups of five females each were formed, corresponding to the dosages of the preparation tested (250, 150, 100 and 50 units of the hormone). The fifth group served as the control. The test animals in each group were chosen taking into consideration their estrous cycle. The hormone was administered simultaneously to all of the animals. The litter sizes of test and control females are shown in Table 1.

It can be seen from the Table that the dosages of 150 and 250 units are the most effective. The yield of young ones per female is greater in these groups than in the control group. A dosage of 50 units is less effective.

The females were allowed to mate starting on the third or fourth day after the administration of this preparation. Some 65-70% of the females mated between the sixth and the tenth day. The number of females mating decreased significantly after the tenth day, and ceased altogether after the 15th to 20th day.

The time of administration of the preparation relative to the stage of reproduction is extremely important. When the estrous cycle has ceased or is on the wane, successful mating of the female is difficult and cannot be guaranteed. In such cases, the method of hormone administration should

Table 1. Litter sizes of test females

Animal group	No of animals	Dosage of preparation, units	No of cubs born	No of surviving cubs	Percentage	No of dead cubs	Percentage	Total No of cubs per litter	Surviving cubs per female
I	5	250	52	45	86.5	7	13.5	10.4	9
II	5	150	49	44	90	5	10	10	9
III	5	100	49	39	80	10	20	10	8
IV	5	50	38	32	84	6	16	7.6	6.4
V	5	control	40	33	82.5	7	17.5	8	6.4

be changed by altering the dosage of the preparation, the number of administrations and the interval between two administrations

THE USE OF GONADOTROPIC HORMONES FOR ACTIVATING SEXUAL PROCESSES IN BLUE AND SILVER-BLACK FOXES

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In animal breeding practice, there are many instances when outwardly healthy females do not show any signs of male receptivity in spite of satisfactory feeding and living conditions. Clinically, this is manifested in the absence of signs of the estrous cycle. These phenomena are noticed not only in the young, but also the older females, which have littered many times before. A vixen in this condition shuns the approaching male and, as experience has shown, if a stimulating preparation is not administered to her, she remains sterile without signs of heat until the end of the calendar periods for heat. The percentage of single females remains high.

In 1975 and 1976, the authors carried out tests with gonadotropic hormones in order to stimulate the sexual function. Females with disturbed sexual function were divided into two groups. One of them consisted of animals which had littered in previous years. This group was subdivided into two groups. The first subgroup consisted of females in which the delay in the onset of heat relative to the period of mating in the previous year did not exceed two weeks. The second subgroup covered females in which this delay was two to four weeks. Females with the same delay in heat formed the controls. The second group of test females was comprised of young animals, which were again divided into two subgroups. The first subgroup consisted of females in which signs of heat were totally absent, while the second subgroup consisted of females with a sluggish estrous cycle.

Suitable schemes were drawn up to treat the experimental groups of animals with gonadotropic hormones. In all, 172 females were used in the test. These included 34 silver black foxes and 138 blue foxes. Of the 34 silver black foxes, 32 females mated and 21 of them littered to yield a total of 110 cubs. Thus, the average yield per littering female worked out to 5.2 cubs. Not one female from among the three controls whelped.

Of the 138 blue vixens treated with gonadotropic hormones, 98 littered well which works out to 71%. The females which did not whelp numbered

40, i.e., 29%. Of the 10 controls, only two females littered, i.e., 20%. The 98 littering females gave birth to 997 young ones, i.e., 10.6 per female. Of the young ones born, 949 survived, i.e., 9.7 young ones per female. The two control females produced 11 young ones and of these three died.

Thus, administration of gonadotropic hormones to blue and silver black vixen during the period of heat reduced the number of sterile animals, and also increased the yield of young ones per littering female.

A NEW METHOD FOR INDUCING THE ESTROUS CYCLE IN MINK

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Investigations (Bernatskii and Nosova, 1972) have revealed that ovulation occurs in all female minks which mated two days consecutively at the optimum period of heat (March 9-11)

After the first period of mating, ovulation occurred in 9.25 ± 0.76 of the follicles and after the second in 8.05 ± 0.5 of the follicles

Considering that over 90% of the fertilized ova died after the mating of the females in the later period of heat, the possibility was considered of limiting the mating in minks to one cycle (one or two consecutive days). Tests carried out on 184 females at the Kostromsk and Rechnaya fur farms showed that the mating of females on two consecutive days from March 10-15 (in only one estrous cycle) reduced fertilization. As a result, the yield of kittens per female in the group decreased by 0.7 to 0.8. This situation can be explained by deterioration of the ova in a group of females due to the time of mating or the inadequate secretion of progesterone by the *corpus luteum* (yellow bodies) formed after a single ovulation.

In order to verify these assumptions, numerous tests were carried out in 1975 and 1976. The first ovulation was induced by injecting gonadotropic hormones (synthetic fatty acid or choriogonin). Starting on the seventh day after the injection, the females began mating with males for one day or on two consecutive days. Test and control groups (mating two or three times during heat) were comprised of females of the same litter. Females of the same origin were mated with the same males. Fertilization of the test females was in no way inferior to that of the controls (96.0-98.2 versus 99.5-96.0 in the controls). In the test group (administered choriogonin), as a result of increased fertility, the yield of kittens increased significantly (5.4 ± 0.43 and 5.91 ± 0.25 against 4.46 ± 0.55 and 5.37 ± 0.29 for the controls).

This method of inducing heat encourages polygamy among males by nearly twofold, controls the onset of heat in the females and significantly reduces the labor required during the period of heat.

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EFFECT OF ULTRAVIOLET IRRADIATION ON THE REPRODUCTIVE CAPACITY OF FEMALE BLUE FOXES

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Work on the irradiation of female blue foxes was carried out between 1975 and 1976 on the Fur'evsk fur farm in Kaliningrad district.

In 1975, two groups of females (test and control) were formed, each consisting of 29 animals selected on the principle of analogues. The animals were kept under identical living and feeding conditions.

Irradiation was carried out between January 28 and the time of laying using PRK-2M lamps. The females were accustomed to irradiation gradually. On the first day, the exposure was one-eighth of the dose, on the second one-fourth, on the third one-half and from the fourth day the full dose was given. When computing the irradiation dose, voltage variations of $\pm 10\%$ in the network, the age of lamps at the time of use and also the percentage of ultraviolet radiation reflected by the grid of the pen (15%) were taken into consideration. The lamps were placed on the roof of the pen 90 cm from the floor and 60-70 cm from the back of the animal being exposed. A single dose was 300 mer (millicquivalents of rontgen) hr/sq.m. The total dose for the entire period of irradiation was 26,000 mer-hr/sq.m. Only females of the test group were exposed.

The mean date of mating (in March) was 21.0 in the test group and 22.8 in the control. The duration of gestation was the same in both groups.

The number of sterile females or females which suffered abortions or gave defective births was roughly the same in the experimental as well as in the control group (four or five animals, respectively).

Every female of the test group, which littered well, yielded an average of 11.4 kittens; for the control females (unirradiated) this value was 10.2.

The average weight of kittens was 3.6% higher in the litter of test females than in the litter of control females.

The 1976 test comprised two groups of females (test and control), each containing 25 animals selected on the principle of analogues. The living and feeding conditions were identical for both groups.

The test group animals were irradiated between February 1 and the time of littering using PRK-2M lamps. Each 10-day period of irradiation was followed by a rest period of five days, the technique of irradiation remaining as before. A single dose was 200 mer-hr/sq.m and the total irradiation for the entire period was 12,000 mer-hr/sq.m.

In 1976, the estrous cycle of test females commenced three days earlier. The average date of mating was four days earlier (dates in March): in the test group it was 24.8 and in the control group 29.1. The number of sterile females decreased (2 and 5, respectively). The yield per female in the test group was 0.7 kittens more.

The kittens of irradiated females weighed 7.6% more than those of control females (123 and 114 at five days after birth).

The weight loss of females of both groups remained the same before heat; the loss of weight during the period of gestation was 0.38 kg in the test females. This was favorably reflected on the state of the females (lesser emaciation during lactation) and also on their milk production.

The favorable effect of ultraviolet irradiation on the organism of blue vixens is confirmed by the blood picture. Hemoglobin was 0.86g% more in the blood of irradiated females (in irradiated it was 13.74 ± 0.33 g% and in unirradiated 12.88 ± 0.20 g%), and erythrocytes were 1.07 million/mm³ more (in irradiated 6.94 ± 0.31 million and in the control 5.87 ± 0.49 million/mm³). The difference in both cases was significant.

These investigations demonstrate that ultraviolet irradiation significantly improves the reproduction of female blue foxes.

EVALUATION AND IMPROVEMENT OF THE SEX FUNCTIONS OF MALE MINKS

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The development of mink breeding on a commercial scale calls for further improvements in the organization of several production processes, including reproduction. A characteristic feature of minks is that they reproduce once a year and deficiencies during the course of the estrous cycle or laying cannot be rectified in the same year. This adversely affects the financial and field activity of an organization.

Hence, the selection of males and females with normal sexual functions and the prediction and control of these functions are important aspects of improving the reproductive indices. As shown by experience, many mink breeding farms have scope for improvement since the percentage of sterility among females ranges from 5 to 20 on different farms.

One of the factors responsible for sterility among females is their mating with males which have impaired functioning of their sex glands. The proportion of such females works out to 2-3% (Johanson, 1963 and Bogachev, 1973). Under much wider polygamous conditions than at present, this index may increase.

At present, two methods are available for evaluating the sexual functioning of males: the preliminary method involving the control of testicular development and the growth of appendages, and the second method involving the quality control of sperm.

The control of the development of testes is effected by the method of palpation of the testes and their appendages before rut. This reveals morphological defects quite accurately: underdevelopment or absence of testes or appendages, tumors, injuries and so on. In mink herds the absence of testes is encountered in roughly 2% of the males, underdeveloped testes in 1.8% and cryptorchism in 0.1%. An abnormal morphological state of the testes is invariably accompanied by a disturbance in sperm formation or its release from the ejaculatory duct. This method, when used systematically, helps to enhance the fertility of females by 3.3% and the yield of kittens per female of the main herd by 0.1 kitten. A deficiency in the method is that it does not lend itself to objective evaluation of males for their sperm quality or their future sexual activity.

The control of sperm quality is effected by taking a portion of the semen from the vagina of females immediately after coitus, by means of a pipette, and examining the sperm under a microscope. This is done during the period

of heat. It enables the males to be assessed rapidly for their sperm quality. A drawback of the method is the impossibility of obtaining identical portions of the semen of different males due to the peculiarities of the reproductive system of minks. Sperm just cannot be extracted from some males though they reproduce normally.

In light of the above discussion, it would be highly promising to develop a method for evaluating males for the quality of their sperm obtained by means of a power-operated ejaculator. With this in mind, the authors have designed a universal portable electrical ejaculator with changeable components.

THE DEVELOPMENT OF FUR FARMING IN THE YAKUT AUTONOMOUS SOVIET SOCIALIST REPUBLIC PRESENT STATE AND PROSPECTS

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The Yakut Autonomous Soviet Socialist Republic supplies 10 million rubles worth of fur to the state annually. Fur farms account for 48-50% of this.

Silver black foxes and blue foxes are bred on the state farms of the Ministry of Agriculture and on the specialized Kholbos consumer cooperative farm. While the farms of the Ministry of Agriculture are small, using agricultural byproducts and farm wastes, the consumer cooperative farms are comparatively large specialized units. One of them, Pokrovsk farm, that raises silver-black foxes and blue foxes, produces fur valued at over a million rubles, which is one quarter of the dressed fur supplied by farms in the state.

However, the average indices of effective litter yield and fur quality on the state and consumer cooperative farms continue to remain low. This situation can be explained by the smaller amount of breeding work done, careless checking of the feed norm requirements of fur-bearing animals in different biological cycles, disturbances to the age structure of the herd and the absence of any evaluation of the breeding quality of the animals or their purposeful selection.

In order to enhance the reproductive capacity of local silver-black and blue foxes and to improve the quality of their fur, the Yakutsk farms annually import a large number of juvenile bloodstock from different state breeding farms of the All Russian Production and Scientific Combine of the Fur Farming Industry, within the Russian Soviet Federative Socialist Republic.

Because of significant differences in the climatic and feeding conditions, the large number of year-old females in the herd and differences in the

structures of hairy pelts, the massive import of juvenile stock does not have a favorable effect on the qualitative indices of fur farming

For basic improvement in the productivity of farm-bred, fur-bearing animals and for enhancement of the quality and quantity of fur production, bloodstock should be raised regionally

The productive indices of the large specialized Pokrovsk fur farms are on a par with the indices of certain individual bloodstock breeding farms in the country, and hence they could be converted into bloodstock breeding farms

Thus, bloodstock breeding work on the Pokrovsk farm should be aimed at raising juvenile silver-black and blue foxes with high breeding and productive qualities, that are adapted to the local environmental conditions. Further development of fur farming on the commercial farms of the Republic should aim at a great concentration of these juveniles, improved organization of their feed base, strict adherence to the principles of breeding work and greater attention by senior zoological and veterinary specialists and farm directors to this branch of the economy.

RELATIONSHIP BETWEEN MORPHOLOGICAL INDICES AND THE CONDITION OF THE PELTS OF BLUE FOXES IN RELATION TO THEIR SIZE AND FATTENING BEFORE SLAUGHTER

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From 1974 to 1976, studies were carried out on the Roshchinsk state fur farm on the relationship between live weight, body length, and fatness of blue foxes and the size and quality of the pelts obtained from them. In terms of each of these indices, the animals were subdivided into three categories. The indices of animals with moderately developed characteristics were within the range $M \pm 0.5b$ while those of large and small ones were greater than $M + 0.5b$ or less than $M - 0.5b$.

A systematic association was established between the body length, live weight and fatness of the animals and the size of their pelts. The length and area of the pelts of large animals were significantly greater than those of the smaller ones. Blue foxes of average size occupied an intermediary position in this regard.

Results of pelt grading demonstrated that larger pelts were obtained from the much larger and better fed animals. The percentage of normal pelts was lower among those obtained from litters with a smaller body length. A reverse relationship was noticed between live weight and fattening. The lower the weight or fattening, the greater was the percentage of defect free pelts. The most widespread defects were scratches and abrasions on the skull and these were seen more often on the pelts of large animals.

The effect of selection on the strength and quality of blue fox pelts was studied. For this samples of skin with the hair were investigated. These samples were drawn from blue fox of the second generation of breeding with large and small body lengths.

Large and small blue foxes showed no significant differences in the density of top hair and underfur. No significant differences were observed also in the quality of top hair and underfur in the tufts, the number of tufts in a group and the number of top hairs and underfurs in a group.

The thickness of the guard hair was significantly greater in large animals than in small ones. A significant difference has been noticed in the thickness of underfur of females while there was no such difference in the underfur of males.

The underfur is much longer in large blue foxes than in small ones. The length of guard hair is significantly longer in large females while only a tendency toward elongation of the guard hair is noticed in males as a result of their fattening.

Conclusions

1 The fattening of blue foxes helps yield pelts of larger size. However, the pelts of extremely fat animals are characterized by numerous defects, primarily scratches and abrasions on the skull.

2 Selection of blue foxes for fattening, based on their body length in the first stages, does not result in thinning of their hair coat. On the other hand the hairs tend to become longer and thicker.

MORPHOLOGICAL AND HISTOCHEMICAL INVESTIGATIONS OF THE BLOOD OF BLUE FOXES AND MINKS

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The object of the present investigation is a morphological and histochemical study of the blood of blue foxes and minks at the time of their slaughter, since such data are not available in literature

The blood of 50 blue foxes and 53 minks in the age group of seven to eight months was used for the investigations starting in December 1974 and in 1975

Blood smears were stained by the Romanovskii-Giemsa, May-Grünwald and Papenheim methods. RNA in the blood was identified by the Brash method. Blood leukocytes were also studied. The macro- and micro-elements were determined in the whole blood by chemical methods.

Among the macro elements calcium, phosphorus, iron, potassium and sodium were identified, while among the micro-elements copper, manganese, zinc and cobalt were identified.

Morphological investigations established that the blood of blue foxes and minks aged seven to eight months possessed a lymphocytic profile. The blood of blue foxes contained lymphocytes 53.3%, monocytes 7.1, neutrophils 36.4, eosinophils 2.2 and basophils 1%. The blood of minks contained lymphocytes 58.1%, monocytes 6.6, neutrophils 31.1, eosinophils 2.7, and basophils 1.5%.

Granulocytes in blue foxes and minks had a highly lobed nucleus, especially the neutrophils and eosinophils. In the blood of blue foxes, the average number of lobes in the nucleus of neutrophils was six and the maximum nine, while in the eosinophils the nucleus was usually divided into four lobes and its maximum was seven.

In the neutrophils of mink blood, the average number of lobes in the nucleus was seven, with a maximum of 14, and in the eosinophils the average was six and the maximum 11. The nucleus of basophils in foxes and minks had two to three, sometimes four lobes. The neutrophils and eosinophils of mink blood had a more highly lobed nucleus.

Histochemical studies established that the cytoplasm of lymphocytes and monocytes was more pyroninophilic than that of granulocytes.

A high content of macro- and micro elements was observed in the blood of blue foxes and minks.

The macro elements present in the blood (in mg %) were calcium in

blue foxes 9.4, in minks 18.1, phosphorus in foxes 36.6, in minks 41.1, iron in foxes 50.4, in minks 48.7, sodium in foxes 270.0, in minks 367.0 and potassium in foxes 142.0, in minks 182.0

The micro elements in the blood (in $\mu\text{g } \%$) were copper in blue foxes 0.15, in minks 0.30, zinc in foxes 0.50, in minks 0.70, cobalt in foxes 2.1, in minks 3.8 and manganese in foxes 2.6, in minks 3.6

The above data show that the blood of minks contains more macro- as well as micro elements than that of blue foxes. This is evidently associated with the metabolic activities of the animals under study.

CHANGES IN THE SIZE OF MINK PELTS DURING PRELIMINARY TREATMENT AND DRESSING

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Studies on the changes in the size of mink pelts during preliminary treatment and dressing have been carried out on the experimental farm of the NIIPZK during the slaughtering season

Results of the measurement of length, width and area of the pelts of male and female minks at the stage of preliminary treatment, after a two-month storage of freshly dried pelts and after their dressing, have been analyzed. For experimental purposes the carcasses with their pelts were taken and their length and width from behind the shoulders measured. Skinning and degreasing of the pelts were carried out manually. Male pelts were straightened on a No. 0 roller and female pelts on a No. 2 roller. Temperature and humidity of all the buildings were measured by a thermometer and a psychrometer. The pelts were rolled in wooden drums 1.6 m in diameter rotating at 18 revolutions per minute, without any warming of the fillings.

Investigations showed that the length of the pelts of female and male minks increased during the processing stages, reaching a maximum after straightening. Compared with the carcasses, the length of male pelts rose by 60.5% and that of female pelts by 47.6%. After rolling on the flesh and hair side, the pelt underwent a shrinkage of 4.5% in the case of males and 1.9% in the case of females in comparison with the dried skins. The storage of freshly dried pelts for two months led to their shrinkage by 2.4 cm (3.6%) in the case of males and by 3.3 cm (5.8%) in the case of females. The dressed pelts underwent a shrinkage of 9.5 cm (14.6%) in the case of males and 8.2 cm (15.2%) in the case of females in comparison with the freshly dried ones.

After a two-month storage freshly dried pelts of males recorded a width reduction of 0.6 cm (4.1%) and an area shrinkage of 72 cm² (7.4%). The pelts of females correspondingly shrank by 1 cm (7.2%) and 92 cm² (11.8%).

Compared with freshly dried pelts, after dressing the semifinished products, the width and area of female pelts decreased by 0.4 cm (3.1%) and 120 cm² (17.4%) while the male pelts enlarged in width by 0.9 cm (6.5%) and shrank in area by 62 cm² (6.9%).

The area of pelts on the carcasses, compared with the freshly dried ones, was 132 cm² (12.8%) more in males and 96 cm² (12.2%) more in females. The semifinished product showed the least surface area.

Conclusions

1. During preliminary treatment and dressing mink pelts vary considerably in their length, reaching a maximum on the straighteners but later they suffer shrinkage during rolling, storage and dressing into semifinished products.

2. The pelt area is significantly less in the freshly dried form than on the carcass.

3. The technology of dressing results in shrinkage of mink pelts along their length and in area in comparison with raw pelts.

FREEZING OF NONDEGREASED BLUE FOX PELTS

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Work on the freezing of nondegreased blue fox pelts was carried out on the NIIPZK experimental farm and on the Timokhovsk state fur farm during the peak slaughtering seasons of 1974 and 1975

Test and control pelts were selected based on the principle of analogues taking into consideration their origin, live weight, body length and the quality of fur of the animals

Control pelts were not subjected to the freezing process. Test pelts were frozen at temperatures of -10 to -12 , -13 to -15 and -20°C . Rapidly frozen pelts with the flesh or hair outward were placed within one day on three shelved, wooden racks. Later, half of the pelts were packed in polyethylene bags and the rest stored in a refrigerator without bags. All of the test pelts were placed in cold storage for 20 days. Later they were removed, thawed at room temperature in the same manner as the control hides and subjected to further preliminary treatment according to the current directions for preliminary treatment of the pelts of fur bearing animals on fur farms (1971).

Investigations showed that the test pelts in the freshly dried and dressed forms were not inferior to the control pelts in size. The defects seen on the pelts were not related to the temperature, time or method of freezing.

Physical, mechanical, chemical and histological indices showed no significant differences between test and control pelts.

The distribution of test and control pelts into groups according to the types of defects was roughly the same.

The freezing of steamed, nongreased blue fox pelts would be economically advantageous to fur farmers. It helps avoid delays in the handling of animals during the slaughtering period and thus reduces feed consumption as well as defects in the pelts.

In 1975 and 1976, 2,500 blue fox pelts were frozen annually for up to two weeks in a cold storage on the NIIPZK test farm. This realized a savings of about 5,000 rubles a year. Moreover, the working day of the labor engaged in the preliminary treatment of pelts became better regulated.

Conclusions

Freezing nongreased, blue fox pelts at a temperature of -10 to -20°C

1) did not lead to loss of size or pelt quality in the raw and semifinished forms;

2) helped reduce the maintenance time of the animals during the period of their slaughtering and thus effected savings by reducing the expense of feeding the animals and by decreasing pelt defects.

SOME OBSERVATIONS ON CAPTIVE MINKS RELEASED FOR THE PURPOSE OF INTRODUCING THEM INTO THE LOCAL BIOCOENOSIS

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In 1975, the Tyumensk administration of game management and farming, in accordance with the plan for biotechnical measures, was to release American minks into the farmland along the Syn River in the Polar Urals for purposes of acclimatizing them. Toward this objective, in the middle of June 1975, 200 standard minks aged one to two years were brought to the Gorky state farm located 200 km away from the site of actual release. Three males and one female perished during transport.

On release, an overwhelming majority of the animals immediately left the transport cages and set out toward water. Many of the tiny animals tried to bathe right there. The females were more active than the males.

The more domesticated minks approached man with confidence and did not turn away when the men approached the cages. The released minks were under observation for three weeks and fresh feed supplements were added every one or two days.

Fish and the viscera of waterfowl were given as feed supplements. Minks took to extremely diverse types of feed—gruel with meat, cake and especially dried egg powder and butter. The animals completely consumed the feed supplements throughout the period of observation. Simultaneously, they began to drink water independently. The excrements of tiny animals 8-10 days after birth (51 samples) were collected from the transport cages. In these were found the remains of extremely diverse natural feeds: mammals 32 times, fish 21 times, birds 18 times, insects 17 times, amphibians (tadpoles) 15 times, reptiles (lizards) once, invertebrates (caddis flies) once, and exclusively the remains of feed supplements twice.

A study of the data collected showed that, in all cases, the minks simultaneously consumed several types of feeds.

On analyzing the feed components according to type, it was found that the remains of mammals were encountered eight times, birds three times, fish once and insects once. Within two weeks after release, it was frequently noticed that the minks were extracting feed from the water.

In the opinion of the author, the released minks should not be given feed supplements for longer than two or three weeks, since they begin to get

used to a regular supplementary feed and do not attempt to secure food by themselves

Within two or three days after release, most of the animals had made themselves comfortable in different types of hideouts. Though many of them come out regularly for their feed, they were found around the pen less frequently each day. One mink did not use the feed supplement at all.

Three or four days after release, a mink was noticed floating on the Syn River and swimming on the lake a few kilometers away from the site of release. Ten to twelve days later mink tracks were found 3 or 4 km away from the site of their release. Not a single instance of the death of these minks was noticed within three weeks of observations.

Conclusions

1 The release of minks in the Polar Urals was successful. Within the first few days of their independent living, the minks began to scatter and colonize the area. They learned to secure diverse types of feed and search out and use natural hideouts.

2 During transport, the cages containing minks should be protected from the direct rays of the sun.

3 The minks released should not be given feed supplements for more than two or three weeks and the amount of supplementary feed should be gradually reduced.

EXPERIENCE IN CAPTIVE BREEDING OF THE KAMCHATKA RED FOX

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In 1972, the laboratory for breeding fur bearing animals at the VNIIOZ undertook work on farming the Kamchatka red fox.

Young Kamchatka red foxes (26 animals) caught by the author in the Kamchatka region and silver black foxes caught by the Vyatka fur farm of the VNIIOZ served as the breeding stock.

Red Kamchatka foxes were bred in pure form, or red cubs were obtained from hybrid red females, which had been mated with wild Kamchatka red males.

As a result of the mating of Kamchatka red males (wild) with silver-black females litters were obtained consisting wholly of red cubs as well as litters which, along with red hybrids, also contained northern Siberian gray foxes. The color inheritance pattern of the hair coat detected pointed to a genetic diversity of the herd of silver black foxes on the Vyatka fur farm.

Following four years of experiments on the farm breeding of Kamchatka red foxes at the Vyatka farm by January 1, 1977, the stock had grown into 81 red females and 29 red males. Ninety four red foxes were given for breeding to the Sokalsk fur farm of the Ukrainian consumer cooperative and 267 animals were killed and the pelts given for auction at Leningrad. In the January 1976 auctions, the best of the Kamchatka red fox pelts produced on the Vyatka fur farm were sold for 300 dollars each.

During the period of investigation (1973-1976), 638 red Kamchatka and northern Siberian gray foxes were obtained and reared.

The results achieved by the Vyatka and Sokalsk fur farms point to the possibility of successfully rearing Kamchatka red foxes on the other consumer cooperative farms as well.

CHANGES IN THE LIVE WEIGHT OF HYBRID FOXES WITH AGE

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Many scientists and field workers have studied growth problems among animals

A study of the growth patterns and the rearing of hybrid animals is of immense practical importance. By knowing growth patterns, the maximum body size can be achieved and the productivity of animals enhanced.

Unfortunately, however, data are not available in literature concerning the growth and development of young hybrid foxes. It would therefore be of interest to study the growth processes of first generation hybrids obtained by crossing Kamchatka male red foxes with silver black vixens and thus identify the most intense growth period.

A study of the general principles of postembryonic growth of first generation hybrids was carried out on the Vyatka fur farm of the VNIIOZ in 1973 and 1974. The growth of the animals was studied by comparing the results of linear, bulk and weight measurements.

When born the hybrid kittens were, as a rule, larger, more energetic and more active than the silver black kittens. The males at birth weighed an average of 136 ± 4.2 g and the females 132 ± 2.0 g, i.e. the weight difference between kittens of the two sexes was insignificant. The weight variations ranged from 105 to 150 g. This was characteristic of females as well as males and persisted until the adult stage. By 10 days of age, the weight of kittens (males and females) had doubled, by one month it had risen 7.5 times and by three months 26 times in females and 29 times in males. By six months of age, the weight of females had risen 43 times and males 49 times in comparison with their respective weights at birth.

The absolute growth rate of hybrid juveniles varied in a fixed pattern for most of the farm bred, fur bearing animals under study. Hybrid juveniles experienced their most rapid growth during first three months. In the first month the relative mean monthly weight increment was the same in females and males at 149.8%, but later the females grew less rapidly than the males.

In the first ten days the absolute mean daily weight gain of females averaged 16.7 g and of males 16.9 g, in the second ten-day period the weight gain increased in females to 27.9 g and in males to 28.9 g. A rise in the mean daily increment was noticed up to three months of age, but later this index

fell. The level of absolute increment was higher in the males than in the females.

On November 1, the hybrids differed from silver-black foxes in their much larger size; the males weighed an average of $6,495 \pm 200$ g and females $5,474 \pm 100$ g. The trunk lengths were correspondingly 74 ± 1.0 and 69 ± 0.7 cm.

Hybrid females and males showed more significant weight differences ($P=0.90$ and $P>0.99$) than those of silver-black foxes.

With respect to linear changes, significant differences were noticed in the body length of males ($P>0.95$) in favor of hybrids, while no such difference could be seen in the females ($P<0.90$). In the girth behind the shoulders and the length of posterior extremities, a significant difference was noticed ($P>0.95$ and $P>0.99$) in favor of hybrid females.

Thus, preliminary experiments in the study of the growth of first-generation hybrids lead to the conclusion that the wild red Kamchatka fox has a positive influence on the growth and body size of the hybrids.

The study of the growth of hybrids of subsequent generations forms the subject of further investigations.

INCREASE IN THE WEIGHT OF THE LIVER OF SILVER-BLACK FOXES DURING PREGNANCY AND LACTATION

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This paper presents some of the growth characteristics of the liver of silver-black foxes during pregnancy and the early postnatal period.

Nine fetuses, 10 newborns, 36 kittens up to one month of age and 3 kittens five months of age were investigated. The specimens were collected from the Zabaikal'sk fur farm in the Buryatsk Autonomous Soviet Socialist Republic, using animals which had been killed or which had died for reasons not associated with diseases of the internal organs.

The weight of the liver in the fetuses and kittens varied significantly: the absolute weight of the liver during the gestation as well as the postuterine growth periods of silver-black foxes increased nonuniformly. Thus, in the fetuses which had developed for 25–35 days the liver weight rose by 1.4 times and for 35 to 45 days by 2.9 times. By the time of birth, the bulk increase in the liver had slowed down, i.e., by that time, the weight of the organ had risen by only 1.3 times. From birth to the fifth day, the increase in the liver weight of the kittens was very slow. A rapid increase in liver weight took place up to the tenth day. Later, from the 10th to the 15th day, the weight rise somewhat slowed. At the same time, from the 15th to the 20th day, the absolute weight of the liver rose sharply from 5.26 g to 11.80 g, i.e., by 2.1 times.

The growth of liver lobes during the investigation period proceeded nonuniformly; in the 25-day-old fetus, the absolute weight of the right lobe of the liver was more than that of the left lobe. From 25 to 35 days, the weight of the left lobe rose by 1.6 times and the right lobe by 1.2 times. Later, by the 45th day of fetal growth, the absolute weight of the right lobe rose far more rapidly than the left lobe. By the time of birth, the weight increase in the liver lobes was proceeding at a fairly even tempo. Later, up to the first 10 days of postuterine growth, the weight rise of the right lobe of the liver in cubs was again more rapid than that of the left lobe. By the 15th day the intensity of liver growth varied: sometimes the left lobe and sometimes the right lobe grew more rapidly. An equal increase in the absolute weight of the liver lobes sets in only by the 35th day of the fetus and by 30 days of age in kittens.

From a comparison of the weight increases of body and liver, it can be seen that, with age, the relative weight of the liver decreases.

During the gestation period the relative weight of the liver continuously decreased from 11.4% in 25-day-old fetuses to 3.8% in newborn kittens. It then rose with wide fluctuations to 5.4% in 20-day-old kittens. Subsequently, the relative weight of the liver gradually decreased to 3.5% in 30-day-old kittens. It is significant that in five-month-old silver-black foxes, liver weight was only 3.2% of body weight.

MALE AND FEMALE MORTALITY IN LITTERS OF AMERICAN MINKS

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It is well known that males predominate in the litters of American minks. According to the data of N V Grakova (1974), 50.93 ± 1.19 to $52.66 \pm 1.77\%$ of newborn kittens of standard colored parents were male. It is highly profitable to produce more males as their pelts are larger and better priced. A certain number of kittens are stillborn and some very weak ones perish in the first few days after birth. We calculated the sex composition of stillborn kittens or those that had died in the first few days after birth on the Vyatka fur farm, based on the data collected by a single brigade (farm unit). All of the kittens born were taken into consideration and the sex of the majority of them determined. In all, 8,480 kittens were produced, including 629 (7.4%) stillborn. Of the latter, the sex was determined for 499 kittens: 248 ($49.7 \pm 2.22\%$) were males and 251 ($50.3 \pm 2.22\%$) females.

Furthermore, the sex of 495 kittens which had died before registration was determined. These were mainly weak individuals which had died due to natural causes. This did not include one kitten lost for unknown reasons or those bitten to death by the females. Among the dead, males predominated ($55.0 \pm 2.21\%$). Though the difference in the sex ratio between the stillborn and the dead kittens is statistically insignificant ($t=1.7$), the trend of mortality changes with sex is quite significant and can hardly be regarded as random. For example, the whole sample (including stillborns) consisted of $51.3 \pm 0.62\%$ males. The dead kittens included 3.7% more males ($t=1.6$). Thus mink litters showed a tendency toward the predominant death of males postnatally. During pregnancy and birth, on the other hand, more females died.

The data on the relationship between the number of stillborns and the litter size are of interest (Table 1).

From the data presented in the table, no direct relationship can be seen between the number of stillborn kittens and the litter size: a high mortality rate was noticed in large as well as small litters. The lowest number of stillborns was in litters consisting of six or seven kittens. Evidently, this is the optimum litter size for American minks of standard color.

These data suggest a way of reducing prenatal mortality among kittens. In particular, it would be advantageous to form herds with animals which have a fertility of five to nine kittens, and primarily females littering six or

Table 1. Number of kittens stillborn to females of different fertility rates

No. of kittens in the litter	No. of females	Total No. of kittens	Stillbirths	
			No.	% ($M \pm m$)
1	32	32	7	21.9 \pm 7.3
2	41	88	11	12.5 \pm 3.52
3	34	162	19	11.7 \pm 2.44
4	86	344	29	8.4 \pm 1.5
5	166	830	66	8.0 \pm 0.94
6	265	1,390	63	4.0 \pm 0.49
7	277	1,939	120	6.2 \pm 0.55
8	209	1,672	141	8.4 \pm 0.63
9	105	945	75	8.0 \pm 0.83
10	50	500	52	10.4 \pm 1.36
11	21	241	32	13.2 \pm 2.17
12	8	96	11	11.5 \pm 3.45
13	1	13	—	—
14	2	28	3	10.7 \pm 5.84

seven kittens. Taking into consideration the high mortality of males in the first few days after birth, the males and females should be weaned separately and placed under good foster mothers. Many experiments need to be carried out, however, before recommending the optimum norms for such a transfer of kittens of different sexes to foster mothers.

POSSIBILITIES FOR USING CONTACTLESS (AURAL) RECORDING OF THE PHYSIOLOGICAL INDICES OF FUR-BEARING ANIMALS

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A solution to the problem of contactless recording of the physiological state is of utmost importance. There is no doubt about the achievements of contactless methods in studying the physiological processes as these methods ensure the observation of the dynamics of these processes in intact animals found in different functional states. By applying these methods, information can be successfully obtained on the functional activity state in sleeping animals and in newborn kittens during the very early stages of postnatal development. It is practically impossible to register any of these functions using contact methods.

One method of contactless recording of the functioning of an organism is the recording of aural patterns. This method has no aftereffect on the organism under study. This distinguishes the aural method from other similar methods (registration using light, ultrasonic waves, high frequency radiations or investigations using radioactive decay).

The aural recording of functions is based on the following characteristics of living beings. It has been established that the activity of an organism is not exclusively limited to the anatomical contours of its body, but is also seen in the form of electromagnetic fields generated by the organism, which are propelled into the space around it at the velocity of light. Living beings actively generate around themselves an 'electrical aura', which gives information about the functional state of their organs and tissues. Contactless aural information, without disturbing the state of the organs, provides us with information collected from the space surrounding the organism without having to touch the body. The aural field is recorded by a vector aurator according to the method developed by A A Zhdanov in the laboratory of physiological cybernetics, Leningrad State University. The aural pattern can be recorded using any automatic recorder (inking type, electrical circuit type, etc.) or on a strip of magnetic tape. For this purpose, we usually used the inking type electrocardiograph.

The results of our experiments show that this method holds immense possibilities for studying the physiology of the cardiovascular and respiratory systems of fur bearing animals in the very early stages of postnatal development when other methods (electrocardiograph, pneumography, etc.) are difficult or altogether impossible to use.

HEREDITARY PREDISPOSITION TO RICKETS-LIKE DWARFISM

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On several fur farms, defects in body structure such as stunted trunk, clearly visible curvature of the vertebral column or defects in the feet are regularly encountered among juvenile minks

An analysis of the possible genetic predisposition to rickets like dwarfism and the nature of its transmission were studied based on zoological data from four divisions of the Timokhovsk state mink farm (five years) and two to seven divisions of the Pushkinsk (two years) and Raisino (one year) state farms

Of the over 6,000 litters examined, defective kittens were found in 13-86% of the litters. In the litters in which segregation has been noticed, 19.0-24.9% defective kittens have been registered in some years. This corresponds to Mendel's law of segregation (3:1) resulting from the mating of heterozygotes having one pair of alleles each ($Dd \times Dd$). Statistical tests did not establish differences between actual segregation and theoretically anticipated levels. An analysis of genealogical data confirms the correctness of this conclusion.

The parents producing defective kittens in their litters can be regarded as heterozygotes (Dd). In their litters, 25% are normal animals (DD), 50% heterozygotes (Dd) and 25% ricket dwarfs (dd).

The parents of defective kittens transmit genes which predispose half of all their litters to defective growth. Thus, half of the phenotypically normal but defective half-sibs, which are at present extensively used in the main herd and supplied to other farms, carry the defective gene and thus represents a constant source of heterozygotic parents.

Based on the number of segregated recessive homozygotes, the approximate theoretical number of heterozygotic sires has been calculated by year. The actual number of females which clearly manifested the defective gene (13-86%) was two or three less, but the number of males (5-25%) came close to the theoretically anticipated mark. This phenomenon is quite clear. Males give rise to litters with several females and hence the probability of their encounter with heterozygotic sires is very high. The high number of litters increases the chances of segregation of recessive homozygotes.

Thus, some of the animals, especially the females, do not show themselves as carriers of the defective gene.

A comparison was made between females yielding only normal litters with females having defective kittens with respect to the time of birth of the kittens, their sex ratio, and reproduction indices. This comparison did not establish any difference. Differences were noticed in the number of defective kittens born in different years from their near-total absence to 5-6%.

These differences cannot be explained by breeding practices. They suggest that animals of a certain genotype may be normal or may have aberrant body structure depending on environmental conditions, i.e., certain (mostly feed) factors promote the manifestation of this defect in minks which are predisposed to it. Thus, defects can be controlled in two different ways by eliminating the feed factor and by discarding the animals reacting to it.

The following recommendations are made for the breeding of minks.

1 Commencing with the weaning from mothers, a thorough check should be maintained of all kittens with rickets like dwarfism and this should be recorded in the register of juveniles.

2 All male sires in litters with even a single defective kitten should be discarded. Particular attention should be paid to identifying the carriers of the defective gene among the males since their offspring are more numerous than those of females.

3 Females bearing defective kittens should be removed from the main herd for purposes of breeding. A portion of these females with good reproductive indices may be mated with highly productive males, i.e., use them for analyzing the genotype of the males. The offspring should be slaughtered.

4 Normal and defective half sibs (of the same litter or the offspring of a father with other females) should not be used as bloodstock nor should they be supplied to other farms.

5 Males carrying the defective gene are better mated with the female carriers or suspected carriers of the defective gene so that their offspring can later be totally discarded.

DAILY RHYTHM OF MOTOR ACTIVITY IN BLUE FOXES

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Data were collected in the summer through round the clock visual observations of blue foxes kept in pens and cages by recording their behavior at intervals of five minutes. The area of a pen was 78 sq m and of a cage only 2 sq m. Thus, the former was 40 times larger than the latter. In the pens the blue foxes were kept in pairs. A pair of white and a pair of blue foxes were under uninterrupted observation for 45 days. Thirty blue foxes kept in cages were also under observation for three days. The latter animals were kept singly.

Considerable individual diurnal variations were noticed in the distribution of motor activity among the blue foxes held in pens. This could be seen partly from discrepancies in the maxima and minima of the activities in different animals on the same day and in a given animal on different days (Fig 1). On determining the average values for the entire period of observation the following characteristics of the dynamics of diurnal rhythm were noticed. In all three groups of blue foxes, dusk night activity predominated (Fig 2). No significant rise in the activity of blue foxes was noticed during the hours of feeding. The sharpest fall in activity was early in the

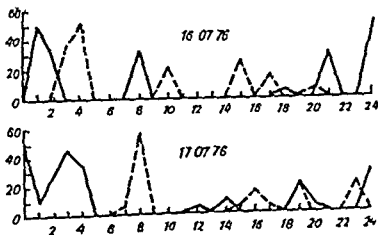


Fig. 1. Distribution of motor activity over the course of a day in blue foxes. The solid line shows the duration of the motor activity in minutes; the abscissa shows the time of day in hr. — fox No. 1 and ---- fox No. 2.

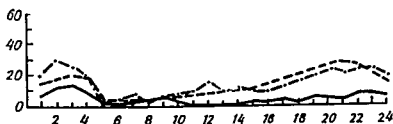


Fig 2 Dynamics of the diurnal activity of blue foxes in summer. The ordinate shows the duration of the motor activity in minutes, the abscissa shows the time of day in hr, — blue foxes in cages, -.-.-.- blue foxes in pens and - - - - white foxes in pens

morning before sunrise. This low activity level in the early morning hours has been noticed among predators before (Shcherbakova, 1949). At this time of day, in the wild, predators usually conclude their nocturnal hunt. As can be seen from Fig 2, limiting their living space or confining the blue foxes singly reduced the level of their motor activity, but did not exert any significant influence on the dynamics of the diurnal rhythm in these animals. This was by and large the same in the white and blue foxes, but the latter were evidently more active in the early morning hours, while the white ones were more active in the evenings (Fig 2).

MOTOR ACTIVITY OF BLUE FOXES

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Round-the-clock visual observations of the behavior of blue foxes were made at the Vyatka fur farm for three days continuously in July 1975. Adult animals, 15 males and 15 females aged two years, were under observation. These were kept in separate cages. The activities of the animals were noted at intervals of five minutes. Using a similar method, observations were made at the biological station of the VNIOZ on two pair of blue foxes kept in 78 sq m cages. As a result of the analysis of different forms of behavior among blue foxes, it was found that the animals rested most often in a rolled-up position or stayed inside. The predominant form of motor activity was pacing, while the rarest was playful behavior (Table 1).

Table 1 Forms of motor activity among blue foxes kept in cages
(number of encounters a day)

Form of activity	Females		Males	
	lim	M	lim	M
Pacing	2-36	16.60	3-32	17.40
Running	0-8	1.56	0-11	1.92
Rising	0-8	2.40	0-8	2.16
Jumping	0-6	0.96	0-6	1.20
Climbing	0-2	0.24	0-2	0.24
Playing	0-2	0.05	0-2	0.13

On reviewing the different forms of behavior among blue foxes, it was found that periods of rest predominated significantly over movement. It was seen that the activity of blue foxes was three times greater in pens than in cages (Table 2).

Table 2. Diurnal sleep and movement among blue foxes (in hours)

Living conditions	Sleep			Movement		
	Females	Males	Average	Females	Males	Average
In cages	18.00	16.72	17.36	1.83	1.92	1.87
In pens	13.00	12.52	12.76	5.80	6.48	6.14

Limitation of their living space was not the only factor which depressed the activity of caged blue foxes. One of the vital factors adversely affecting their motor activity was the confinement of the animals singly. Thus, when these foxes were held in pairs in the pens, playful activity was noticed up to 20 times a day, and of all forms of playful behavior noticed, playing with the partner was significantly predominant. Among the 30 foxes confined to cages, playful behavior was noticed only in eight animals and not more than twice in a day over a three-day period of observation.

The females were more frequently noticed sleeping and the males moving (Table 2). Further, the females rested more often within the 'tiny home' while the males did so in the enclosure. On the whole, sleeping in the enclosure was encountered slightly more often than in the 'tiny home'.

In the 1975 reproductive season, no relationship was seen between the duration of sleep and the reproductive capacity among the experimental blue foxes. Similarly there was no correlation between the motor activity of males and their sexual activity while as might be expected, a reverse correlation ($r = -0.63$) was seen between the motor activity of females and their fertility. The experimental group contained three sterile females which kept moving about for more than three hours a day, while the mean diurnal activity for this group of females as a whole was 1.83 hr (Table 2).

INHERITANCE OF WEIGHT CHARACTERISTICS IN MINK

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Starting in 1975 selection was carried out on the Vinnitsk fur farm in order to evolve a herd of large minks of dark brown silver-blue and sapphire colors. With this in mind, in the autumn of 1974, the farm set out to form divisions of large minks. The task was to segregate into groups large female minks weighing 1.3 kg or more and males weighing 2.3 kg or more. Since, however, the number of animals weighing that much was not adequate to complete the divisions, animals with a lower weight than the prescribed standard had to be selected (Table 1).

Table 1 Standard weight of groups from the main herds of large minks

Sex	Weight kg		
	Dark brown	Silver blue	Sapphire
Females	1.0-1.6	0.9-1.5	1.0-1.5
Males	2.0-3.1	1.8-2.9	2.0-2.5

The minks selected for breeding were put on feeding levels as shown in Table 2.

Processing and analysis of the results showed that the weight indices of the juveniles born on October 1, of large parents were 8-10% more than those of the juveniles in the common herd. Before October, the weight of the large group juveniles did not differ from that of their contemporaries in the rest of the herd. After October 1-15, there was large weight increase, which continued through December. The weight increase ceased earlier in the females than in the males.

From an analysis of the results, it follows that the greater the weight of the parents, the larger is the size of their offspring. Both parents transmit their weight characteristics but, evidently, to different extents. This assumption is confirmed by the data shown in Table 3.

Table 3 supports the premise that the father's share in the weight characteristics inherited by their offspring is more than that of the mother's. Daughters inherit the weight index of their mothers to a greater extent than

Table 2. Average monthly feeding characteristics of minks between 1974 and 1976

Month	No. of instalments		Digestible matter per instalment, g		
	Adults	Juveniles	Protein	Fat	A nitrogenous extract
January	2.4	—	11.20	3.07	3.41
February	2.2	—	10.96	3.34	3.82
March	2.5	—	11.40	3.00	3.60
April	2.5	—	11.84	3.10	3.43
May	4.3	—	11.04	2.84	3.72
June	2.5	1.8	11.03	3.96	2.92
July	2.6	2.8	9.56	4.04	3.53
August	2.8	4.0	9.82	4.20	3.67
September	3.5	3.5	9.82	4.00	4.10
October	2.8	3.5	9.70	3.80	4.40
November	3.0	—	10.90	3.83	4.20
December	2.6	—	10.97	3.36	3.97

Table 3. Coefficient of inheritance of weight characteristics among minks

	Dark-brown	Silver-blue	Sapphire
Mother-daughter	0.42	0.82	0.18
Mother-son	0.40	0.40	0.30
Father-son	0.90	0.62	0.76
Father-daughter	0.62	0.84	0.04

Note: The coefficient has been calculated using the formula $h^2 = 2r$

sons. The nature of weight inheritance in sapphire minks differs from that in dark-brown and silver-blue foxes. In sapphire minks, mothers transmit their weight characteristics to the daughters to a lesser extent than that to the sons. Daughters do not inherit the weight characteristics of their fathers.

FETAL MORTALITY AMONG CHINCHILLAS

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Long tailed chinchillas differ from all other farm bred, fur bearing animals in their relatively low fertility. According to continuous observation on the VNIOZ chinchillas farm, the female fertility was an average of three young a year (range 1 to 11). At the same time, the chinchillas are a polyestrous species with monthly recurrence of the estrous. Gestation extends for an average of 111 days and the females are capable of laying two or three litters annually, each consisting of 1 to 5 young. However, the average size of the litter does not exceed two since over 50% of the fetuses perish in the maternal uterus (Kiris, 1972).

According to the data of H. Hillemann and F. Tibbitts (1957), on US chinchilla farms, 75% of the fetuses die before birth and only 25% of the reproduction potential is realized. According to these authors this is a characteristic of all members of the chinchilla family (*chinchilla viscacha* etc.).

In order to study the high fetal mortality and the death of embryos during different growth stages, the author investigated 120 uteri of gestating females which had died at different times on the VNIOZ chinchilla farm or had been slaughtered as rejects. The gestation period was determined from the size of fetal swelling and the growth stage of the fetus from its external characteristics. The standards for this purpose were the dated embryonic material obtained from eight females while studying the embryogeny of chinchillas (Kiris, 1973). The state of the fetus and all abnormal features were noted: resorption, mummification, dissociation and, in the terminal stage of gestation, any deformity in fetal structure or incorrect position of the fetus in the maternal passages.

Investigations carried out in recent years have established that the implantation of fetuses occurs in the chinchillas roughly 10 days after fertilization and the fetal swellings attain the size of a pea after a 15-day gestation period. In a series of investigations of female uteri, the earliest implantation encountered was a 20-day gestation and the latest was on the eve or on the day of littering. The death of fetuses before implantation, as established from the difference between the number of corpus lutea in the ovaries and the number of swellings in the horn of the uterus, was 29.5%.

Fetal mortality was recorded in half of all gestating females. Further the number of dead fetuses was 40.4% including 14.4% of resorbed embryos.

2.7% of mummified embryos and 23.3% of fetuses with characteristics of dissociation. Among 11 stillborns, four were freaks with the intestine growing outside the abdominal cavity, with defective extremities and curved spine or jaws. In five instances, incorrect position of the fetus was noticed. Deaths of fetuses were noticed in all growth stages, but more often in the latter half of the gestation period.

Most of the dead fetuses were females, which had been attacked by noninfectious diseases (affecting the organs of digestion, reproduction or respiration) or by infectious diseases (listeriosis and paratyphoid) which are fairly prevalent on the farms. The number of dead embryos was lower among the clinically healthy females, which had been slaughtered or killed as a result of accidental factors (trauma, heat stroke, and so on). In all, 4.2% of the fetuses of sick females were dead, the corresponding number among the clinically healthy females was half this, or 2.16%.

Based on the investigations carried out, it may be stated that, in chinchillas, the death of fetuses after implantation is to a large extent associated with the state of health of the gestating females.

Strict compliance with the rules of hygiene for the maintenance, feeding and care of the animals, especially of gestating females, should help in reducing embryonic mortality, thereby enhancing the fertility of females. The high percentage of fetal deaths due to infection of the digestive organs in females (38.8) points to the necessity of exercising special care in the quality of the feed. Chinchillas are particularly choosy about their feed requirements.

VARIATIONS IN SOME OF THE MORPHOLOGICAL CHARACTERISTICS OF CHINCHILLAS

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Investigations into the acclimatization of chinchillas in the Soviet Union were started by rearing them in cages. The initial population of these animals on the experimental farm of the VNIIOZ comprised 49 females and 47 males on January 1, 1961. Every year, the population of the main herd continued increasing and by early 1967, it reached 300. At the end of that year, along with the young, the ranch contained 700 animals at one time. However, starting in 1968, according to information from the Central Board, the chinchilla population on the farm was artificially cut down and by the middle of 1972, the main herd was brought down to 20 pairs, including 20 females.

The breeding of chinchillas for 15 years in a small herd and the impossibility of carrying out selective breeding could not but reflect on the characteristics of the animals. The most objective criterion describing the peculiarity of the animals is their weight and hence all of the animals on the farm are regularly weighed. An analysis of the data pointed to a successive increase in the mean weight of the animals at a relatively constant rate starting in 1964, when the average age composition of the herd was 2.7 years. For 10 years (from 1964 through 1974), the average weight of a chinchilla rose by 20%, the females becoming 17% heavier and males 25%, so. As a result, the weight differences between males and females narrowed down significantly. While this difference in 1964 was a statistically significant index ($t=4.6$), it was clearly insignificant in 1974 ($t=0.99$). In the last five years, the weight of newborn chinchillas has risen by 7% compared with the long-term mean and the growth of the young has proceeded more rapidly than in the past. In this same period, compared with the young of 1961 to 1968, the weight of three-month old chinchillas averaged 15% more and that of six-month-old 12% more.

The increase in the weight of adult animals and the more rapid development of the juveniles in recent years on the experimental chinchilla farm of the VNIIOZ may be ascribed to the availability of good quality feed and special care. At the same time, the gradual loss of certain morphological characteristics, which are unique to chinchillas, may be noticed among the juveniles.

Considering that the cranial dimensions of these animals are stable and

fixed by heredity within relatively narrow limits (Shvarts, 1965), the author carried out a comparative analysis of the craniometric indices of chinchillas from two collections of skulls gathered on the VNIIOZ farm from 1961 to 1968 and 1969 to 1975. For purposes of comparison the skulls of year old animals were used since these were most numerous in the author's collection. Of all the measurements, the increase in skull length was significant to a high degree ($t=5.1$). Further, elongation occurred due to a flattening of the rostrum, nasal bones ($t=3.1$) and diastema ($t=5.6$), while the cerebral portion of the skull remained almost unchanged. Changes traced in the skull were noticed in the live animals. Among juvenile chinchillas, a particularly weak constitution was noticed with increasing frequency. They acquired an elongated facial portion and lost the hook shape of the nose characteristic of chinchillas. According to Schauffelen (1959), the hook nose of the chinchillas evolved as a result of the broad nasal cavity designed, among other functions, for warming the cold air inhaled by the animals in the high altitude climatic conditions of their natural range. It may be assumed that with the rearing of chinchillas over a long period of time on farms within fairly constant temperature limits, the altitude no longer being of any importance, the hook nose of the chinchillas became a recessive characteristic. Simultaneously, the juvenile chinchillas on the VNIIOZ farm gradually lost the structure and color of the pelt which are characteristic of the species. The clearly manifested dark foginess disappeared and the animals increasingly took on a mouselike form. It is possible that the impairment of certain morphological features of chinchillas is associated with long term inbreeding. In this respect, an attempt was made in 1974 to freshen the blood of the animals by importing five pairs of chinchillas from the German Democratic Republic. But the animals came through the zoological society without any records and their breeding properties were poor.

Future buying of chinchillas from abroad should be done only in consultation with the VNIIOZ workers or at least the purchases should conform to the requirements of the VNIIOZ.

PECULIARITIES OF THE REPRODUCTION OF STANDARD BAIKAL MINKS ON THE BOL'SHERECHENSK STATE FUR FARM

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The animals on Baikal fur farms are known for their fairly high fertility. The Bol sherechensk state fur farm has achieved the highest and most stable indices for the yield of kittens, and this has aroused great interest in a study of the reproductive capacity of standard minks on this farm. These data have been obtained in a study of the experimental results and an analysis of the production records of the first brigade for the period 1969 to 1976. Feeding was in accordance with the general norms of the farm and was of a fish meat type with an increase in the proportion of pollock in the feed each year. The estrous cycle occurred on March 3 to 5. Mating of the females occurred once in the first period of heat and once or twice in the second or third periods. The intervals between estrous periods were 7 to 10 days. The annual average number of matings per female was 3.34, the actual number varying from 1 to 7, the maximum number of females mated 2 to 4 times.

An analysis of the data for different years showed that in 1969, 4.55 live kittens were produced per female mated, subsequently, the index rose gradually and reached 6.1 kittens in 1976. Over an eight year period, female insemination rose from 79.8% to 92.1% and fertility by 19.7%. The number of females giving birth to dead kittens (specific proportion of stillborn kits in litters), though not constant, varied little in different years.

This increased female fertility was achieved by selection control of the fertilizing capacity of males and their care before the rut, testing the sperm and analysis of the litters of mated females.

It has been found that the productivity of a herd depends on its age structure. The maximum productivity is in two-year-old females and in two to three-year old males. Older females, while maintaining a high fertility, showed a significant decrease in fertilization, and stillbirths were more common in their litters. Males older than three years had a low fertilizing capacity.

The fertilizing capacity of males exerts a significant influence on female fertility. The more fertile females are those mating with males which fertilized all of the females in a group and the less fertile ones are those mating with

males whose harem remained partly sterile. A statistically significant association between female fertility and the sexual activity of males is seen only when the males have a 100% fertilizing capacity. Young males brought in from other farms and well prepared for the rut increased the fertility of females in comparison with the local one-year-olds.

Conclusions

The high yield of useful young on the Bol'sherechensk state fur farm was achieved by enhancing insemination and increasing the fertility of females.

The insemination of females was influenced by their age and the age and fertilizing capacity of the males.

Fertility of females in the initial stages depended on selection; later, it depended largely on the age of the animals, the fertilizing capacity of the males and partly on their sexual activity.

EMBRYOGENY OF AMERICAN MINKS (*MUSTELA VISON* BR.)

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The system of G. A. Schmidt has been the main classification for the gestation periods of American minks (Kolpovskii, 1974). The prefetal and fetal periods of embryogeny isolated by him, though having distinct boundaries, reveal common morphogenesis, structures and topographies of provisional organs and position of fetus. However, the embryonic period represents an exceptionally broad subdivision of embryogeny in the classification. It combines extremely divergent processes of morphogenesis and different methods of feeding the embryo.

The mink fetus grows from zygote to blastocyst by the eighth day after coitus. During this period is formed the first provisional organ of the fetus, the trophoblast, which ensures the feeding of the blastocyst. As a result of embryonic diapause, the embryo may remain in the blastocyst stage for up to 49 days after coitus. A characteristic feature of these stages of embryogeny is the growth of the embryo within the membrane of the ovum—the *zona pellucida*.

The disappearance of the *zona pellucida* is associated with the completion of embryonic diapause and the resumption of the tempo of intrauterine growth characteristic of minks. The trophoblast sets itself free from the *zona radiata* 29 days before birth. In this same period, fragments of transverse folds of endometrium begin to be seen. In the subsequent two days of embryonic development, the volume of the trophoblastic villi increases, the embryo grows to the embryonic disk stage and symmetrical transverse villi are formed over the entire surface of the endometrium (Kolpovskii, 1971). On the 26th day before birth, the embryo attaches itself to the uterine wall in the folds of the uterus to the folds of the endometrium. During implantation, the primary stria lies antemesometrially, almost in a straight line position and across the long axis of the horn of the uterus. On the 20th day before birth, spherical fetal chambers 2.5 mm in diameter are formed in sections of the surface of embryonic implantation. By the 23rd day before birth, the dimensions of the fetal chamber increase and the embryo preserves the position it had during implantation. In the embryo can be seen the cerebral vesicle, visceral arches, an S shaped heart, a notochord, a closed nervous system which extends almost throughout its length and the first pair of somites.

In spite of the perceptible growth and complexity of the embryonic anatomy, embryogeny from the 29th to the 23rd day before birth has one essential common characteristic, the basis of which is implantation. This represents the mechanism that triggers the formation of the placenta. At this time the yolk sac is formed and this serves as the first organ of embryonic nourishment. Attachment of the fetus by the placenta, according to the author, is not a single act, but is a process of successive development of embryonic and uterine adaptations ensuring intimate contact between the organism and the fetus. The establishment of the primary villous contact of the trophoblast with the endometrium (26th day before birth) only tentatively characterizes implantation since the phenomena which probably should be regarded as a continuation of this process are noticed on subsequent days.

The 22nd day before birth represents the commencement of allantois formation seen as a slit-like cavity disposed along the trophoblast on the side of the tail of the embryo. Later, the allantois grows and fills the antemesometral portion of the fetal chamber. Simultaneous with the growth of the allantois a hematoma is formed, which is a provisional organ of hemochorial contact. Starting the 22nd day before birth, the fetus gradually, and synchronously with the increasing number of somites, turns like a spiral and changes position several times in the fetal chamber. By the 17th day before birth a relative equilibrium is established between the size of the allantois and yolk sacs and the area of contact of their walls with the trophoblast. At the same time, the embryo leaves the yellow sac and places itself fully in the extra-embryonic coelome. The allantoic placenta is formed only toward the end of the prefetal period (Kolpovsku, 1976).

Table 1 Embryological periods among American minks*

Period	Range, in days	Main characteristics
Embryonic	Up to 8-49 days after coitus	Growth within <i>zona pellucida</i>
Implantation	29-23 days before birth	Liberation of trophoblast from <i>zona pellucida</i> primary villous contact of chorion with the uterus, yellow placenta
Flexions of embryo	22-17 days before birth	Flexure of embryo like the turns of a spiral somatic formation, formation of allantois, 'hematoma' and allanto-chorionic placenta, multiple variations in embryo position

*The limits of prefetal and fetal periods of embryogeny have been determined before (Kolpovsku, 1974)

GENITALIA OF AMERICAN MINK (*MUSTELA VISON* BR.) DURING THE DIESTRUS PERIOD OF THE SEX CYCLE

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Information about the post-estral state of genitalia in unmated minks is very scanty and contradictory (Kier, 1941, 1961, and 1971, Hansson, 1947, and Enders, 1952). In order to study the morphology of the ovaries and the uterus in the diestrus period, six minks which had reproduced before were observed. In early January, the females were removed from the main herd and placed in an isolated shed 1.5 km away from the fur farm. The proximity of males was totally eliminated. Once every five days starting on April 2, 1976, the horns of the uterus along with the ovaries were extracted from the minks one after another. The ovaries and the uterus in the estrus period were compared with the corresponding organs of gestating and postnatal minks.

On the surface of natural ovaries there were 8-12 dark red disklets or projecting segments of a sphere up to 2.2 mm in diameter. After fixation in a 4% aqueous solution of formalin, these formations turned yellow or bright brown.

The yellow spheres were true *corpus lutea* as are present during gestation. The *corpus lutea* had a theca, finely-cellular stroma, central cavity and parenchyma. The lutein cells were polygonal and $20 \times 20 \mu\text{m}$ in size, their cytoplasm was oxyphilic and homogeneous. The nuclei were bubble shaped with a diameter varying from 7.5 to $10.5 \mu\text{m}$. On April 17, 1976, the size of the *corpus lutea* became smaller and there were many intercellular spaces in the parenchyma, there were more nuclei with a multiplicity of tiny vesicles, sections with a foam like structure and large vacuoles in the cytoplasm of the lutein cells. Some nuclei were in a state of pyknosis. By the end of the month, the size of the *corpus lutea* had decreased to $0.4 \times 0.5 \text{ mm}$, the theca had disappeared and groups of interstitial cells had formed the outer boundary of the parenchyma. In several cases, isolated groups of up to 8 or 10 *corpus lutea* with distinct characteristics of functional activity were found in the stroma of the ovaries.

The light brown spheres seen on the surface of ovaries were found to be large tertiary (graafian) follicles with luteinized cells of granulosa. Luteinization of follicular epithelium began with the basal layer, the cells became high and cylindrical with dimensions of $7 \times 15 \mu\text{m}$. The cytoplasm of

these cells was homogeneous, light-smoky in color. The nuclei, with a diameter of 6 μm , shifted toward the end of the cells, opposite to the position of the theca. Under the basal layer of the granulosa there were numerous vesicles filled with blood. The cells in the surface layers of the granulosa lay in the form of accretions. In the same ovary, there were also follicles with fully luteinized granulosa. The difference between the structure of the lutein cells of atretic follicles and the *corpus luteum* has not been established. In early April, in such follicles, the ova were surrounded by *corona radiata* and after the second 10-day period in April, the layer of lutein cells surrounded only the extension cavity with a proteinaceous fluid, stray cells of the epithelium and deteriorated material.

In the rest, with the exception of the follicles with luteinized granulosa, the follicular apparatus of diestrous minks was the same as in gestating minks. The primary follicles were few and half of them revealed characteristics of dystrophy. All of the secondary and tertiary follicles had different degrees of atresia. Atresia developed in a definite sequence: initially, the ovum disintegrated and later the follicular epithelium and theca underwent destruction. Defects arising during atresia were filled with young interstitial cells, among which only the compressed *zona pellucida* was preserved.

Changes in the uterus were seen at the beginning of the month. On the longitudinal folds of the endometrium in the antemesometral side of the horns of the uterus there was a symmetrically transverse segmentation. This is characteristic of gestating minks on completion of diapause (Kolpovskii, 1971). Densely scattered tubular glands were found on the entire mucous membrane of the uterus. At the end of April, as well as in the postnatal period, the fragments of transverse folds of endometrium disappeared totally and there was a sharp decrease in the number of uterine glands, the bottom portions of which were greatly enlarged and the epithelium flattened.

In the estrus period, which in minks is as prolonged as gestation, *corpus luteum* or tertiary follicles with luteinized granulosa are invariably present. The yellow bodies (*corpus luteum*) existing during gestation and in diestrus do not differ morphologically. The proliferative processes in the endometrium during diestrus achieve only the stages which are characteristic of the commencement of the implantation period.

ETIOLOGY OF PELT DEFECTS AMONG FARM BRED FUR-BEARING ANIMALS

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Quite a bit of time, sometimes over 1 year, elapses between the birth of fur bearing animals and the use of their pelts in different articles. The hair and skin coats undergo definite changes during this period. Some undesirable variations, classified as defects according to fur standards, can also arise. The reasons for the formation of these defects may be the hereditary predisposition of the animal to different diseases, incorrect feeding and maintenance of animal, improper technology used in the preliminary treatment of pelts and disruptions in the methods of storage, transport or dressing of the fur.

Some 80 types of defects have been identified in the pelts of minks, blue foxes and silver black foxes. Most of these arise during the lifetime of the animal. Some of the more frequently encountered of these defects and those which considerably influence the quality of the raw and semidressed products, are examined below. These defects have been studied by the author in recent years to ascertain the reason for their development and to devise measures for preventing or eliminating them.

It has been established that the reason for such defects as weak skin tissue, matting, hairlessness, sparse hairiness and the presence of unmolted patches is the premature slaughtering of the animals at a time when the growth of the hair coat has not yet been completed. Scientifically based periods for the slaughtering of blue foxes, minks and silver black foxes have been suggested.

Investigations have shown that one latent defect is darkening of the skin tissue, which becomes apparent when the pelt gets wet during dressing. The reasons for the formation of this defect have been established.

Other latent defects (not seen in the undressed pelts of blue and silver-black foxes) are separation of the skin tissue into layers and its brittleness. The author has proposed a specially developed express method to identify these before dressing.

Hair shedding, bald patches, hairslips and weakening of the skin tissue of the pelt are the result of using improper technological methods for the preliminary treatment of the pelts on the farms.

THE MINK STOMACH STRUCTURE AND BLOOD CIRCULATION

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The stomach of adult minks is located in the forestomach region and occupies the entire left hypochondrium. Its anterior limit reaches up to the 10th or 11th rib and the posterior up to the 13th or 14th rib. The anterior limit of the stomach touches the liver (left lobes) and diaphragm. The spleen adjoins the stomach caudally and the small intestine ventrally. As in most predatory animals the mink stomach is in the shape of a flexed sac. It has a capacity of 41 to 112 cm³ and weighs 3.6 to 6 g.

The stomach has a very broad cardinal portion and less broad fundal and pyloric portions. The greater curvature of the stomach is almost 4 to 6 times that of the smaller curvature.

A study of the arteries was carried out using x-ray vasography. For this the arterial system in a mink carcass was filled with white lead diluted with benzene to a creamy consistency. A vesicular preparation was also used.

The investigations have established that the source of arterial blood supply to the stomach of minks is by the coeliac, from which a left gastric artery sets off towards the stomach at a right angle. The left gastric artery approaches the lesser curvature of the stomach and also its cardinal portion where it is divided into much smaller branches. The second source of blood supply to the stomach is the gastro-duodenal artery, set off from the hepatic artery. One of the branches of this artery runs along the greater curvature of the abdomen while a second one runs toward the duodenum. The right abdominal artery also takes part in the supply of blood to the stomach of minks.

The branches of the right and left abdominal arteries anastomose between themselves. A particularly dense network of vessels is seen in the fundal portion of the greater curvature of the stomach which should be kept in mind while dissecting the stomach of minks.

ETIOLOGY OF PELT DEFECTS AMONG FARM-BRED FUR-BEARING ANIMALS

I G Komarova

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Quite a bit of time, sometimes over a year, elapses between the birth of fur-bearing animals and the use of their pelts in different articles. The hair and skin coats undergo definite changes during this period. Some undesirable variations, classified as defects according to fur standards, can also arise. The reasons for the formation of these defects may be the hereditary predisposition of the animal to different diseases, incorrect feeding and maintenance of animal, improper technology used in the preliminary treatment of pelts and disruptions in the methods of storage, transport or dressing of the fur.

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ORCHID MINKS

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Somovsk State Fur Farm for Pedigree Breeding

In 1970, with the object of enlarging the range of pelts, the Somovsk fur farm evolved a new mink form, orchid ($k^{\circ}k^{\circ}$), which was hitherto unknown to breeders. At present, the Somovsk fur farm has 222 females and 46 males of this variety.

Orchid minks are similar to pastel minks in the color of their hair coat. But unlike the pastel minks, the orchids have no dark spots in the color of the hair coat. Most of the animals at present have a blue shade and some show a fairly good bronzy shine. The color intensity varies from light to very dark. The color of the eyes is black or dark brown.

The body dimensions, quality of pelt and productivity indices of females and males are wholly satisfactory for commercial breeding.

The All-Russian Production and Scientific Combine of the Fur Farming Industry came to the conclusion that the breeding of orchid minks would be useful for purposes of enlarging the genetic stock of mink population for the commercial production of pelts of this type.

THE FUR QUALITY OF DIFFERENT SIZED MINKS

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Work was carried out on standard minks of the Pushkinsk fur farm from 1974 through 1976. Different sized minks were compared for quality and also for the density of the hair coat. The results of evaluating live animals suggest that, in these respects, large minks, are significantly inferior to the small ones. Apart from evaluation according to the standards, the density of the hair coat was evaluated by an objective method, for which purpose skin samples with the hairs were taken at random from large (average weight 2,789.2 g and length 49.5 cm) and small (average weight 1,753.8 g and length 44.6 cm) males of standard minks. It was established that the top hair of large animals was much more sparse than that of small animals, but there was no difference in the density of the fur. In the number of top hairs, the difference was 0.8 of a hair per mm^2 in favor of the small animals in direct counting and 0.6 of a hair in histological sections ($P > 0.99$ and $P > 0.90$).

Between the densities of the top hair and underfur, a high correlation was noticed ($r = 0.86$ for large minks and 0.58 for small ones).

The correlation between the weight of the animals and the density of the top hairs was negative. This coefficient of correlation in large minks was -0.29 and in small ones -0.25 and for the two groups as a whole -0.34 . Significant differences in the structure of the hair coat (number of top hairs and underfur in a tuft, number of tufts and underfur in a group and number of tufts per mm^2) were not observed as a rule. An exception was the difference in the number of top hairs in a group. In large males, this index was significantly low ($P > 0.999$).

The length and thickness of guard hairs and the thickness of underfur in male minks of different sizes were practically the same. The length of underfur was greater in small minks than in large animals. The difference was 0.6 mm ($P > 0.999$).

The inverse relationship between pelt quality and size of the animal, established as a result of these investigations, points to the inadequate attention paid by the breeders in selecting animals for these characteristics in their efforts to increase the size of the minks by fattening them.

Considering that large minks constitute a definite percentage of the animals with an excellent quality of hair coat as well as a fairly high degree of heritability of fur density (0.3 to 0.6) (according to the data of Udri'sa, 1966, Kuznetsova, 1969, and 1973 and Bogdanovicha, 1973), the conclusion may be drawn that there are immense possibilities for enhancing fur density and quality while breeding minks for their size.

THE USE OF SUSTANONE FOR STIMULATING THE SEXUAL ACTIVITY OF MALE BLUE FOXES

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Sustanone, a preparation containing a mixture of male sex hormones, was used to activate the sexual function in male blue foxes. The preparation contains 1 ml of an oily solution of 0.03 ml testosterone propionate, 0.06 ml testosterone phenylpropionate, 0.03 ml testosterone isocaproate and 0.1 ml testosterone decanoate. A mixture of the different alcoholic components of testosterone ensures their solubility in the oil, as well as a quick and prolonged effect. Among the components of this mixture, the quickest to act is testosterone propionate, while the action of testosterone phenylpropionate starts 24 hr later and lasts up to two weeks. The action of testosterone decanoate is even more prolonged. A single injection of sustanone decanoate is still more prolonged. A single injection of sustanone is effective for four weeks so one injection a month is adequate.

In our experiments, males which did not perform more than one or two coitus were administered the preparation. In all, 32 juveniles were used in the experiments. Sustanone was administered to 27 blue foxes at a dosage of 0.3 ml, five males were set apart as controls. After administration of the preparation, sexual activity rose significantly. For the test group as a whole, following administration of the preparation, each blue fox performed an average of seven coitus. Adding to this the number of coitus performed before the administration of the preparation, each male performed nine coitus. The sexual activity of the control animals, however, remained at a low level. The five controls together performed only 12 coitus thus showing that the average for this group was only 2.4. If, however, the sexual activity of males treated with sustanone is compared with the performance of animals which did not require any veterinary help, there was no great difference. During the period of rut the normally functioning males performed 9.5 coitus each, while the experimental ones performed nine. Thus, by administering this preparation, the sexual activity of experimental animals was successfully raised to the level of normally functioning males.

Further, the action of sustanone was tested on five clinically healthy males with normal sexual activity. All of these animals were fairly active, moderately fat and worked excellently. The preparation, at a dosage of

ORCHID SILVER MINKS—A NEW COMBINATION

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Somovsk State Fur Farm for Pedigree Breeding

Broadening the range of fur pelts is one of the tasks of rearing fur bearing animals

Orchid silver minks (k°k°rr) have not been described in literature. In order to study their color and the suitability of commercially producing the pelts, these minks were reared from 1971 up to 1973 on the Somovsk farm.

Orchid silver minks are similar to silver-blue minks in their phenotype, i.e., they have a grayish blue coloration varying from a light to a very dark shade with a faint bronzy shine. This shine does not alter the main coloration and is detected only on very careful examination of the pelts.

It is practically impossible to distinguish the pelts of orchid silver minks from those of silver blue minks.

Orchid silver minks have black or dark brown eyes. In their body dimensions, quality of pelt, and reproduction indices, they are in no way inferior to the wine red silver and orchid pastel minks.

At present, the Somovsk fur farm has 130 female and 34 male orchid silver minks.

In view of the fact that the pelts of orchid silver minks do not differ from those of silver blue minks, the All Russian Production and Scientific Combine of the Fur Farming Industry of the Ministry of Agriculture, Russian Soviet Federative Socialist Republic came to the conclusion that the breeding of orchid silver minks was useful for the commercial production of pelts of this type.

ADAPTATION OF SILVER-BLACK FOXES TO THE LOW TEMPERATURES OF THE NORTH

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Agricultural Research Institute of the Far North Noril'sk

Silver-black foxes represent a species of animal which inhabits temperate altitudes. Under the conditions of Karelia, the silver-black fox increases its metabolic heat by 30% at atmospheric temperatures of up to -27°C and by 52% at temperatures of -28 to -34°C (Makridina, 1963).

North of the Krasnoyarsk region, the winter months are characterized by low temperatures and strong winds. The winter of 1976-77 was particularly severe. Thus, at Vorogovo in the Turukhansk region, the minimum atmospheric temperature dropped down to -50°C and wind velocity to 14 m per sec. The mean monthly temperature in December 1976 was -26°C , in January 1977 -29°C and in February -28°C . For comparison, the average temperatures of the corresponding months in previous years had been 5, 10 and 5°C lower.

In order to establish the effect of low atmospheric temperature on the metabolic heat production of silver-black foxes reared for many generations in the Transpolar region, the authors carried out experiments from February 23 to March 2, 1977, on the Vorogovo fur farm. The tests involved a series of experiments on gaseous metabolism in two adult males in hermetically sealed chambers, without air, at temperatures of -28 to -48°C and by warming to -16 to -19°C . Moreover, a series of experiments were conducted under conditions of artificial warming of the air in the chamber to -5 to -9°C .

A chemical heat regulatory mechanism was noticed in the silver-black fox only at low temperatures in the range -28 to -40°C (Table 1).

Table 1

Atmospheric temperature °C			No. of tests	Oxygen requirement, l per kg hr		
Average	Range			$M \pm m$	σ	%
-7	-9,	-5	5	0.77 ± 0.04	0.08	100
-17	-19,	-16	4	0.77 ± 0.04	0.039	100
-33	-40	-28	6	1.04 ± 0.04	0.122	130

*All references to temperature are in degrees Celsius

0.5 ml, was administered immediately after each of the males performed one or two coituses. After the administration of sustanone, the males became perceptibly more active. No difficulties whatsoever were seen in the mating of females by the treated males. Even after mating with all of the females, the males still remained quite active and mated with females of other divisions. Each of the test animals carried out at least 10 to 12 coituses. Thus, the experiment demonstrated that the administration of sustanone enhanced the sexual activity of normal males as well.

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Agricultural Research Institute of the Far North Noril'sk

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North of the Krasnoyarsk region, the winter months are characterized by low temperatures and strong winds. The winter of 1976-77 was particularly severe. Thus, at Vorogovo in the Turukhansk region, the minimum atmospheric temperature dropped down to -50° and wind velocity to 14 m per sec. The mean monthly temperature in December 1976 was -26° , in January 1977 -29° and in February -28° . For comparison, the average temperatures of the corresponding months in previous years had been 5, 10 and 5° lower.

In order to establish the effect of low atmospheric temperature on the metabolic heat production of silver black foxes reared for many generations in the Transpolar region, the authors carried out experiments from February 23 to March 2, 1977, on the Vorogovo fur farm. The tests involved a series of experiments on gaseous metabolism in two adult males in hermetically sealed chambers, without air, at temperatures of -28 to -48° and by warming to -16 to -19° . Moreover, a series of experiments were conducted under conditions of artificial warming of the air in the chamber to -5 to -9° .

A chemical heat regulatory mechanism was noticed in the silver black fox only at low temperatures in the range -28 to -40° (Table 1).

Table 1

Atmospheric temperature $^{\circ}\text{C}$		No. of tests	Oxygen requirement l per kg hr		
Average	Range		$M \pm m$	σ	%
-7	-9 -5	5	0.77 ± 0.04	0.08	100
-17	-19, -16	4	0.77 ± 0.04	0.089	100
-33	-40 -28	6	1.04 ± 0.05	0.122	136

* All references to temperature are in degrees Celsius

0.5 ml, was administered immediately after each of the males performed one or two coituses. After the administration of sustanone, the males became perceptibly more active. No difficulties whatsoever were seen in the mating of females by the treated males. Even after mating with all of the females, the males still remained quite active and mated with females of other divisions. Each of the test animals carried out at least 10 to 12 coituses. Thus, the experiment demonstrated that the administration of sustanone enhanced the sexual activity of normal males as well.

ADAPTATION OF SILVER-BLACK FOXES TO THE LOW TEMPERATURES OF THE NORTH

L. V. Makridina and A. E. Mikhailova

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Atmospheric temperature °C			No. of tests	Oxygen requirement l per kg l r		
Average	Range			$M \pm m$	σ	%
-7	-9	-5	5	0.77 ± 0.04	0.065	100
-17	-19	-16	4	0.77 ± 0.04	0.069	100
-33	-40	-28	6	1.04 ± 0.05	0.122	130

*All references to temperature are in degrees Celsius.

In the series of experiments carried out at temperatures from -16 to -19° , as well as under conditions of artificial warming of the air to -5 to -9° , the gaseous metabolism in the fox was at the same level. The 36% increase in oxygen requirement at low atmospheric temperatures (-28 to -40°) compared with the requirement at comfortable temperatures (-5 to -19°) was statistically significant ($P=0.98$). At low atmospheric temperatures, the diurnal heat production of silver-black foxes also rose by 36%; it was an average of 116 kcal per kg weight against 85 kcal in the comfortable temperature zones.

Thus, silver-black foxes adapted to heat economization under conditions of a temperate climate. However, when exposed to the low temperatures of the Far North, they were compelled to expend a high amount of energy in order to maintain a constant body temperature. Adaptation of these foxes to North Yenisey conditions is possible through perfection of physical heat regulation. This view is supported by the fact that the energy used at an analogous atmospheric temperature drop was less than that under Karelian conditions.

new contemporary ones. There is also the difficulty that the evolved documents have to be agreed to by a wide circle of different specialists. Such work can be carried out, while maintaining quality, only by the efforts of the research groups of several interested institutions with the participation of diverse classes of specialists.

At present, however, the terminology dictionary is being compiled by representatives from only one interested institution and the documents are circulated to different institutions to obtain their comments. However, the compilers cannot obtain genuine assistance through requests for comments on the draft document. Pointing out the drawbacks is not enough. The critics are evidently expected to make well-substantiated suggestions for eliminating them. This is a serious, specialized, difficult work involving an extensive study of literature. Thus, there is only one correct way to handle the complex job of systematizing the terminology and that is by planning it properly.

QUALITY OF FUR COAT IN MINKS BRED FOR SIZE

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B M Zhitkov All Union Scientific Research Institute of Game Management
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At present, breeding minks for size by fattening them is being practiced on a large scale on fur farms. The economic efficiency of this measure is quite obvious and has been clearly demonstrated.

At the same time, the problem of increasing the size of minks necessitates a study of the state and characteristics of the quality of the hair coat, since this has not been studied adequately so far.

The investigations carried out so far have helped to detect certain morphological differences in the structure of the hair coat of large minks. A tendency has been noticed toward an increase in the length of top hairs and much thicker top hair and underfur. These have a better breaking strength and are longer than those of small minks. The greater the size of the pelt, the greater is the thickness of the flesh side and the thicker the compressed hair layer.

Fur density was determined by different laboratory methods (by counting and weighing and by the number of hair roots in the histological sections of skin) and also by grading the juveniles. The density was dependent on the size of the animal and the pelt.

Large females (average weight 125 kg and body length 38 cm) were characterized by denser fur (a greater number of top hairs and more underfur per unit area of the pelt) than females of moderate size.

Among the pelts of males, the sparsest fur came from minks of size category A', which is particularly large.

The data from laboratory analysis of the density of the hair coat have been confirmed by the results of grading the animals on the basis of their weight.

Having noticed less dense fur on large males (pelts of A' category animals), it is necessary to keep in mind that among these, as well as sparsely haired animals, there are animals with dense fur and well developed top hair. The high variability in fur density noticed in minks makes it possible to select animals, specially males, which combine large size and dense fur.

Therefore, in planning ways to fatten minks, it is important to reject large animals with sparse fur and select densely haired animals, even when selecting for size, i.e., according to the phenotype of the mink.

BREEDING OF AMERICAN MINK (*MUSTELA VISON* BR.) ON THE MOZHGINSK STATE FUR FARM

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Ural State University Sverdlovsk

A study of the reproduction of valuable commercial mammals is of great scientific and practical importance. From the intensity of reproduction of the animals, their 'byproducts' can be forecast, their population dynamics judged and fur dressing planned.

In view of the fact that information on the reproduction of American minks in nature is inadequate, the authors undertook an investigation of their reproduction in pens. In 1972, after observing the reproduction of 113 female American minks on the Mozhginsk fur farm in the Udmurt Autonomous Soviet Socialist Republic, the authors established that mating occurred from March 5 up to March 26 and gestation lasted for 36 to 61 days, with an average of 46 days (in 3% of females 36 to 40 days, in 80%, 41 to 48 days and in 17%, 49 to 61 days). Whelping was observed from April 25 through May 11 (72% of females whelped between April 27 and May 5). The number of kittens in a litter varied from 1 to 9, the average being 5.1. As the animals got older, a change in fertility was noticed. Thus, the average number of kittens in the litter of year old females was 5.2, of two year olds 5.93 and of three year olds 4.9.

GENETIC POLYMORPHISM OF TRANSFERRIN AND HEMOGLOBIN IN MINK, BLUE FOX, SILVER- BLACK FOX AND THEIR HYBRIDS

L G Markovich, A V Vladimirov and V N Pomytko

Institute of Fur Farming and Rabbit Breeding, Udel'naya

Diverse forms of antigens and proteins, synthesized by genes at many loci and bearing different names, are seen in various species of animals including farm-bred fur-bearing ones. The object of the present investigation is to study the electrophoretic characteristics of serum transferrin and hemoglobin of erythrocytes in minks and in hybrids of blue and silver-black foxes. On the experimental-demonstration farm of the Institute of Fur Farming and Rabbit Breeding, horizontal electrophoresis on starch gel by the method of O. Smits (1957) and on paper by the method of E. Gurvich (1964), with some modifications, were used to study the polymorphism of transferrin and hemoglobin in standard ($n=886$) and pastel ($n=500$) minks, blue foxes ($n=14$), silver-black foxes ($n=14$) and their hybrids ($n=32$). The hemoglobins of standard and pastel minks were identical in their electrophoretic rate of motion, two allelic forms designated Hb^A and Hb^B have been found. Moreover, a rarely encountered subtype C has been detected. During the inbreeding of standard minks, there was an increase in the concentration of Hb^A genes due to 20 to 50% increase in the number of homozygotic animals with the genotype Hb^{AA} during the test period. In cross-bred animals, as compared with inbreds, the increased concentration of this gene has not been observed. Gene equilibrium is most often disturbed due to a preponderance of heterozygotes in the cross-bred populations and of homozygotes Hb^{AA} in some groups. There is polymorphism in the locus of hemoglobin in blue and silver-black foxes and their hybrids. The two types of hemoglobin identified have been designated A and B, as in other animals, and the electrophoretic variants on paper are more distinct, in the rate of movement, the hemoglobin of hybrids was similar to that of the parent forms. In the populations of standard and pastel minks, genetic polymorphism has been detected with respect to transferrin, and four varieties have been designated depending on their electrophoretic motion: rapid A, followed by B, C and D. Population analysis has shown that animals with alleles A and B are encountered with populations most frequently (34.04 and 47.34%) while C and D are found more rarely (2.68 and 0.69%). The results of electrophoresis of serum proteins were compared with the corresponding values for milch cattle for purposes of standardization. In blue and silver-black foxes and their hybrids, the rate of movement of transferrin

molecules was almost the same as in the minks, but lower than that in milch cattle and rabbits. The rate of movement was much higher in silver black foxes than in blue foxes while the hybrids held an intermediary position. Electrophoretic variants on the same analogy have been designated A, B and C, they are similar to the stage wise polymorphism noticed by I. Formicheva (1974) in the family Canidae (silver black fox, corsac, blue fox and raccoon dog). Hybrid analysis has established the co dominant character of the inheritance of transferrin and hemoglobin among minks. In a small population of hybrids, there was not even a single instance of disagreement between the phenotype of offspring and what had been anticipated on the basis of the hypothesis of 2nd and 3rd allelic systems of the proteins under study. This supports the view as to the co dominant nature of the transmission of these biological structural units. In a test groups of hybrids, the gene concentrations were as follows

$$Tf^A=0.1, Tf^B=0.5, Tf^C=0.4, Hb_3=0.6 \text{ and } Hb_4=0.4$$

The results of these investigations reveal the clearly manifest genetic polymorphism of hemoglobin and transferrin among minks and hybrids of blue and silver-black foxes. This information could be of use when rearing livestock.

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a much shorter period. This would explain the much higher level of metabolism in the late than in the early kittens in the age group 80 to 120 days, as has been demonstrated by the author's earlier experiments.

Therefore, based on the growth pattern of their winter fur, a very short slaughtering period is recommended for farms in Taimyr. In selective slaughtering of blue foxes, it is necessary to take into consideration the sex of early kittens since the hair coat matures more rapidly in early females than in early males.

MATURATION OF FUR IN JUVENILE BLUE FOXES BORN AT DIFFERENT TIMES

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Many Taimyr farms suffer immense losses due to the poor quality of the pelts. Not only the condition of feeding but also the maintenance of the animals are responsible for defects in pelts. The time of slaughtering has no bearing on the pelt quality.

In view of the fact that the general slaughtering period of blue foxes on Taimyr farms lasts for 40 to 45 days and that delayed slaughtering increases pelt defects (Savin, 1969), it would be of interest to see whether there is any relationship between the rate of maturation of the hair coat of fur bearing animals and the period of their birth.

For this purpose, maturation of the hair coat was studied in male and female blue foxes with early and late periods of birth. The study took place on the Potapovsk experimental demonstration farm of the Taimyr National Range in the first few days of slaughtering of the blue foxes (from October 29 through November 1, 1972). The study covered 840 guard hairs (they are the last to mature) of early kittens (20 males and 22 females) born in the first half of May and 820 guard hairs of kittens born late in June (21 males and 20 females).

The results of investigations showed that at the beginning of the period of slaughtering *i.e.*, at the age of 170 days in the case of early kittens and 150 days in the case of late kittens, the number of immature hairs was practically the same (10.6% in the early and 11.1% in the late-born kittens).

The early females were somewhat ahead of the early males in the rate of maturation of the hair coat. Thus, the number of guard hairs with incomplete growth was 14.7% in the early males, while it was only 6.8% in the early females. In this respect, no difference could be established between the late males and the late females.

According to the data of L. G. Komarova (1967), the growth of winter fur in juvenile blue foxes begins on the 73rd day after birth. Under the conditions in Taimyr, the birth of late litters, as compared to early ones, coincides with a significant decrease in daylight and a much lower atmospheric temperature. This results in accelerated maturation of fur in the late juveniles.

At the commencement of slaughtering the number of immature hairs is roughly the same in blue foxes, whether born early or late. This shows that the formation and growth of winter fur among late kittens occurred in

of body weight) was somewhat less than that of the corresponding natural beaters

The process of molting, on the whole, was no different in pups in captivity than in pups in nature, but the molting of emaciated specimens was prolonged and its sequence differed somewhat. Under captive conditions, pups caught during the stage of initial molting, molted fully in an average of 18 days, while those caught during the stage of heavy molting completed it in 10 days.

Such phenomena as inflammation of mucous membranes in the oral cavity, inflammation of the lips and suppuration of eyes were noticed mostly in pups caught early. The authors did not find these diseases among Greenland seals in the wild.

The main drawback of captive rearing of Greenland seal pups is their early removal from the ice floes as a result of which, along with the fattened and heavily molted animals, there are also pups which have not yet completed suckling and hence have not accumulated the required amount of energy resources to ensure normal and timely molting. This results in the appearance of starved animals. Selective catching of the pups based on weight characteristics, so that the larger ones are removed first, is impractical. Thus, captive breeding disturbs the genetic structure of the population with all of the attendant consequences, i.e., diminution and degeneration of the offspring.

STUDIES ON CAPTIVE BREEDING OF JUVENILE GREENLAND SEALS

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Since 1972, the Arkhangelsk fishermen's unions have been carrying out on a commercial scale the rearing of juvenile Greenland seals in captivity. The young caught on the ice floes of the White Sea are brought to the coast in special containers by helicopter and are bred in pens until the molting of primary hair is complete. The principle of this method is based on certain biological characteristics of the animal and is dictated by economic considerations. Roughly a month after birth, the juveniles (white coats) molt their embryonic (fetal) hair coat and grow a new one, at which point they are called beaters. At the peak of molting (stage of crested seal B), the pups cease milk feeding and survive for some time on their own subcutaneous fat reserves. The pelts of beaters are in great demand but it is difficult to catch them—the animals are cautious, they do not form dense congregations and they live on sparsely inhabited ice floes far away from the coast.

Studies on these captive animals were carried out from 1972 to 1976.

The behavior of the pups in pens is mostly determined by their physiological state when caught—their age, degree of fatness and stage of molting. Fat and heavily molted animals have none of the deviations from the normal pattern of behavior that are noticed in underfed animals, i.e., sucking on the hair coat of other animals, eating snow, swallowing pebbles, displaying aggressiveness or, on the other hand, total depression which is not characteristic of them in nature.

The change in the body weight of pups reared in pens depends on the age at which they were placed in the pen—white coat, crested seal A or crested seal B. Depending on this factor, the loss of body weight in captive animals varied from 16–30%, the average being 300–400 g a day, further, the daily weight loss was more significant in the first half of the captive period than in the latter half. The body weight of animals that molted in captivity was lower than that of animals that molted in the natural environments; this difference was 10 kg in 1972 and 4 kg in 1976. The pups placed in pens during the stages of crested seal A or B grew into beaters of moderate body weight—29.2 and 32.7 kg, respectively. The body weight losses were in the former 19.1% (6.9 kg in the range 4.9 to 10.6 kg) and in the latter 8.8% (3.1 kg in the range 1.2 to 6.2 kg).

The fatness of captive beaters (weight of pelt and blubber as a percentage

It is important to determine the interdependence between silver coloration and the development of fur characteristics in order to maintain fur quality when breeding for eliminating the defect. The author found a negative correlation between the spread of the defect and the main features which determine the color and quality of the fur of blue foxes. The effect of direct selection based on silver coloration (0.28) was much greater than indirect selection for color purity (0.04) or fur quality (0.02).

In order to eliminate the defect, a homogeneous selection should be made based on the length of guard hair and underfur of parents with the absence or only slight development of silver coloration evaluated on a point scale and taking into consideration the extent of the silver zone and the density of hairs in this zone in accordance with the parameters discussed above.

MORPHOLOGY, GENETICS AND DEVELOPMENT OF GRAY HAIRS IN THE WINTER COAT OF BLUE FOXES

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Institute of Fur Farming and Rabbit Breeding Udel'naya

Improving product quality is one of the main tasks of fur farming in the Tenth Five Year Plan. Gray hair is a defect in the fur of captive foxes. Outwardly, it is seen as a white strip of platinum hairs between the pigmented tips and the underfur (silver zone). This is an undesirable bloom on the fur.

Investigations have determined the morphological structure of the hair coat on defective pelts, as well as the development, inheritance and association of the defect with the other characteristics of color and quality of the fur.

The morphological structure of pelts with different degrees of the defect were studied in short and medium haired blue foxes. The extent of the section of guard hairs with the silver zone raising above the underfur was significantly more (1.62 to 1.08 cm) in animals with a defect of one to three balls than in animals with a defect of four or five balls (1.13 and 0.84 cm). In animals with the defect, the colored tip of the guard hair is smaller (1.06 against 1.28 cm) ($P > 0.99$). The difference in the amount of guard hair without the silver zone was significant: 7.18% against 52.9% ($P > 0.99$). The variation coefficient of the silver zone in blue foxes was more significant ($P > 0.999$) in the absence or only slight development of silver coloration when the defect was fully developed. This phenomenon shows that when the amount of guard hair without zones is large, even individual hairs covering a large zone do not influence the visibility of the defect.

Information on the growth of silver coloration in the winter hair coat of blue foxes was obtained by examining regularly one year old females. The inspection was carried out once every 10 days starting on September 19. It has been found that the development of gray hair ceased when the hair stopped growing longer.

Special tests were carried out to study the hereditary transmission of this defect. Results showed that, in all types of selection of parents with the defect, the kittens born had different extents of silver coloration but the number of juveniles with clearly visible defects varied. Thus, parents with a defect of four or five balls yielded 45.9% of the kittens with good fur (without silver coloration) while parents with distinct silver coloration gave only 8.2%. The distribution of the litter according to the extent of the defect suggested that this characteristic was caused predominantly by additional genes. The heritability of the defect was 0.28 to 0.37 ($P > 0.999$).

were 15.0 ± 0 , 15.0 ± 0 , and 4.3 ± 0.018 , and the diameters of the uterine glands (in microns) were 30.5 ± 0.048 , 30.0 ± 0 , and 10.0 ± 0 .

The administration of megestrol acetate increased the functional activity of the thyroid gland, a fact which is substantiated by changes in its histological structure. The thyroid epithelium has a cuboidal or cylindrical shape, the follicles are small, the colloid is vacuolated and desquamation of epithelium is noticed in many follicles. On the first day after stopping the administration of the preparation, the thickness of the epithelium (in microns) in the first group was 11.0 ± 0.11 and in the second group 10.2 ± 0.11 . The corresponding diameters of follicles (in microns) were 91.3 ± 0.66 and 90.2 ± 1.08 . On the ninth day, the thickness of the epithelium in the first group was 9.6 ± 0.082 and in the second group 13.2 ± 0.13 , the corresponding diameters of follicles were 81.4 ± 0.94 and 74.8 ± 0.52 .

In the control minks, the thyroid epithelium was small and flat (thickness of epithelium on the first day 4.5 ± 0.11 microns and on the ninth day 5.1 ± 0.055 microns), the follicles were large and had a dense consistency (diameter of follicles on the first day 113.3 ± 1.5 microns and on the ninth day 114.4 ± 0.97 microns).

Thus, the administration of megestrol acetate to minks during the anestrus period stimulates the growth and development of follicles in the ovaries, increases the proliferative processes in the endometrium and enhances the functional activity of the thyroid gland.

EFFECT OF THE PROGESTOGEN MEGESTROL ACETATE ON THE SEX ORGANS AND THYROID GLAND OF MINKS IN THE ANESTRUS PERIOD

N G Nosova

Institute of Fur Farming and Rabbit Breeding Udel'naya

Hormonal stimulation, including treatment with synthetic progestogens, is now widely used to enhance the productivity of farm animals

The purpose of the present investigation is to study the effect of megestrol acetate, a synthetic oral progestogen, on the ovaries, uterus and thyroid gland of minks in the anestrus period

Silver-blue minks received with their feed 200 μg (1 g) and 500 μg (2 g) of megestrol acetate daily from November 23 to 29. Controls were not administered this preparation. From each group, five minks were killed on the first, third, sixth and ninth days after stopping the administration of the preparation.

Investigations showed that the ovaries of the animals which received megestrol acetate tended to increase in size. An analysis of histological slides showed an increase in the number of graafian follicles and in their growth and development. On the sixth day, there were 6.9 of these follicles in the females of the first group and 7.7 in those of the second group but only 2.4 in the control group. On the ninth day, there were 9.3 in the first group, 6.0 in the second group and only 1.7 in the control group.

In the endometrium of the uterus, distinct proliferative changes were noticed under the influence of megestrol acetate. On the first day after stopping the administration of the preparation, the weight of the uterus in the first group of females was 267.0 ± 29.74 mg and in the second group 243.0 ± 0.71 mg while it was only 125.8 ± 6.71 mg in the controls. Correspondingly, the thicknesses of the endometrium (in microns) were 341.0 ± 2.09 , 309.1 ± 2.23 , and 178.2 ± 1.11 , the thicknesses of epithelium (in microns) were 11.5 ± 0.043 , 11.0 ± 0.043 , and 4.5 ± 0.018 , the diameters (in microns) of the uterine glands were 26.5 ± 0.043 , 25.3 ± 0.043 , and 11.0 ± 0.043 .

On the following days, the values of uterine indices in the experimental animals increased steadily and on the ninth day, the weight of the uterus in the minks of the first group was 484.0 ± 57.74 mg and in the second group 453.0 ± 43.18 mg, while it was only 116.0 ± 15.77 mg in the controls. Corresponding thicknesses of the endometrium (in microns) were 407.0 ± 3.12 , 421.3 ± 2.67 and 173.8 ± 0.8 , thicknesses of the epithelium (in microns)

were: 341.3 ± 15.02 and 329.3 ± 7.51 ; 408.1 ± 2.45 and 389.9 ± 2.83 ; 15.5 ± 0.087 and 16.5 ± 0.043 ; and 31.5 ± 0.087 and 31.5 ± 0.043 .

Thus, during the estrus period megestrol acetate inhibits the growth of follicles which leads to a reduction in the number of ovulating follicles, and it has a stimulating effect on the proliferative processes in the endometrium of the uterus.

EFFECT OF THE PROGESTOGEN MEGESTROL ACETATE ON THE OVARIES AND UTERUS OF MINKS DURING THE ESTRUS CYCLE

NG Nosova

Institute of Fur Farming and Rabbit Breeding, Udel'naya

The effect of megestrol acetate on structural changes in the ovaries and the uterus at a dosage of 200 μg was studied in 83 minks. The preparation was administered for seven days along with the feed.

When studying the follicular state of unmated minks, the follicles were subdivided, depending on the degree of development, into the first, second and third stages and the degenerating follicles.

On the third day after starting the administration of the preparation and on the first day after its cessation, the numbers of follicles in the females of the test group were: first stage 3.3 and 4.3, second stage 3.0 and 1.7, the third stage 5.0 and 7.0, and degenerating follicles 2.3 and 3.7. The corresponding values for the control females were respectively 1.0 and 3.0, 1.7 and 1.0, 7.3 and 7.0, and 5.3 and 4.3. The results of analysis showed that the females which received megestrol acetate had more follicles of the first and second stages and fewer of the third stage and degenerating follicles. These data suggest that megestrol acetate delays the growth of follicles. This may be explained by the fact that the preparation inhibits liberation of the follicle stimulating hormone of the pituitaries.

An analysis of the ovaries of mated minks showed that there were fewer ovulated follicles in the females which received the progestogen, than in the controls. In the females which mated only once, the number of ovulated follicles was 11.11 ± 0.8 in the test group and 12.97 ± 1.03 in the controls. In the females which mated twice, the number of ovulated follicles from the two ovulations was 15.83 ± 0.8 in the test females and 17.68 ± 1.11 in the controls. The reduction in the number of ovulated follicles could be explained by the inhibiting effect of megestrol acetate on the growth and development of follicles.

The administration of the progestogen intensified the changes in the uterus before pregnancy. On the third day after starting the administration of the preparation and on the first day after its cessation, the weight of the uterus in the experimental group of animals was 370.0 ± 13.66 mg and 389.3 ± 60.59 mg, the thickness of the endometrium (in microns) 429.9 ± 2.88 and 467.5 ± 3.34 , the thickness of the epithelium (in microns) 18.0 ± 0.043 and 21.5 ± 0.013 and the diameter of the uterine glands (in microns) 33.0 ± 0.043 and 34.0 ± 0.087 . In the control group of animals, the corresponding values

USE OF SHORT-HAIRED BLUE FOXES FOR INCREASING THE SIZE OF LOCAL BLUE FOXES ON THE VYATKA FUR FARM

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The Vyatka experimental demonstration fur farm for breeding livestock has been engaged in the rearing of blue foxes which, in their fur structure, are essentially long-haired. The animals were imported in 1962 from Norway and from the Pushkin state fur farm in Moscow district. In 1972 and 1973, a batch of short-haired blue foxes was imported in order to improve the indigenous fox in color and fur quality.

Regarding the imported fox, the question arises as to whether it can be used as a means of improving the long-haired blue fox not only in color and fur quality but also in size.

During the slaughtering season, 657 animals born that year were handled. They were weighed, body lengths were measured from the tip of nose to the base of tail along the body flexure and chest measurements were taken behind the shoulders. Pelt length was measured, in accordance with GOST specifications, from the central point between the eyes to the base of the tail and the width in the midportion of the pelt.

A comparison of linear-weight indices showed that the most highly developed were the short-haired blue foxes. The females as well as the males were characterized by greater live weight and size than the long-haired blue foxes. The differences in all of the indices were significant ($P > 0.99$).

Since the size of the animal determines the pelt size, it is understandable that the pelts obtained from short-haired blue foxes were larger than the pelts of long-haired blue foxes. Significant differences were noticed in the length and width of the pelts of females as well as males ($P > 0.999$).

The hybrid obtained by mating the long-haired with the short haired fox occupied an intermediary position with respect to its weight and body size.

In live weight, body length and chest circumference, the animals were better developed than the long-haired blue fox. This suggests that the short haired blue fox could serve to enhance the size of the long haired blue fox.

Thus, the results of these studies point out that the short haired fox could be used to enhance the size of the local foxes on the Vyatka state fur farm.

EFFECT OF VARIOUS ECOLOGICAL FACTORS ON THE REPRODUCTIVE FUNCTION OF SABLES

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The most important physiological functions of an animal are controlled not only by its heredity but also by several other factors, which act on the individual animal

Therefore, these investigations were based on an ecological approach to the comparative study of the reproductive processes in sables. The results of these studies open the way for further work on the optimal parameters for the rearing of sables, specially under conditions controlled by the microclimate

In particular, it has been established that, under natural conditions, the air temperature in the nests of wild sables throughout the year was above freezing stable and ranged from $+15$ to $+23^{\circ}\text{C}$. This was so regardless of the temperature of the surrounding air. On the other hand, the pens of sables on farms varied widely in autumn, spring and winter, dropping down to -10 to -15°C . In all probability, this significantly delayed the process of sexual maturity in the juveniles

The authors established that the natural illumination in the pens of sables was variable throughout the year. On the average, it was 5 to 40 times less than the corresponding values in open sites outside of the shed

There is no doubt that under captive conditions, sables experience a deficiency of this important ecological factor, including ultraviolet radiation. This is also confirmed by the fact that implantation of blastocytes and their rapid development ending in whelping occurred in February when, after the autumn winter period, there is a sharp rise in insulation (specially from February through April)

Body temperature measurement of most of the sables in pens were made with allowance for the pen conditions, temperature of the surrounding air and the age of the animal

The main reasons have been found for the migration of sables when they are released into new habitats, specially when the sites where they were caught and where they were released differed noticeably in their ecological characteristics

It has been established that, under certain difficult ecological conditions, the process of sexual maturation can be delayed not only in captive, but also in wild sables

THE DYNAMICS OF 17 β -ESTRADIOL TESTOSTERONE AND PROGESTERONE IN THE PERIPHERAL BLOOD SERUM OF BLUE FOXES DURING REPRODUCTION

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The endocrine mechanisms involved in the reproduction of fur-bearing animals are now being widely investigated. These studies will allow purposeful control over the reproduction processes in animals. The endocrine function of the ovaries of blue foxes has been studied very little.

In this work we have described the levels of 17 β estradiol, testosterone and progesterone in one year old female blue foxes in different stages of the reproduction cycle. The sex hormones were determined by radioimmunological methods using highly specific antisera.

In the period of heat, the concentration of 17 β estradiol in six animals ranged from 34 ± 27 pg/ml to 80 ± 42 pg/ml. Three days before the last mating there was a distinct rise from 37 ± 12 pg/ml to 80 ± 42 pg/ml and on the day of the last mating, the hormonal level dropped to 36 ± 7 pg/ml. The concentration of testosterone in these same periods before the last mating varied in the range 209 ± 97 pg/ml to 538 ± 313 pg/ml. Three days before the last mating, the testosterone level in the serum plasma increased to 538 ± 313 pg/ml while during the last mating it fell to 210 ± 73 pg/ml. The progesterone content 6 to 14 days before the last mating was at the low level of 76 ± 22 pg/ml to 149 ± 70 pg/ml. Six days before the last mating there was the beginning of a sharp rise in the concentration of progesterone in the serum plasma while, on the day of last mating, its level went up to $23,441 \pm 3,619$ pg/ml.

During gestation, on the fourth and eighth days after the last mating, the concentrations of 17 β -estradiol were 37 ± 7 pg/ml and 46 ± 13 pg/ml respectively. In the next few days this decreased to 27 ± 10 pg/ml. On the 22nd day of gestation, the hormone level was 34 ± 20 pg/ml. In the subsequent period of gestation, before whelping, there was some drop without any significant fluctuations.

After whelping, during the 14 days of lactation, the level of 17 β estradiol was in the range 19 ± 7 pg/ml to 7 ± 7 pg/ml, while in the period of gestation it had been 43 ± 18 pg/ml to 262 ± 10 pg/ml. On the fourth and eighth days after the last mating, the testosterone levels were 212 ± 133 pg/ml and 240 ± 137 pg/ml, respectively. In the next few days of gestation there was a slight

EFFECT OF 17 β -ESTRADIOL AND PROGESTERONE ON THE PROCESSES OF MATING AND OVULATION IN SABLE

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The biology of reproduction among sables especially the main endocrine mechanisms controlling reproduction, has not been adequately studied so far in spite of the fact that studies on the hormonal control of mating, ovulation and other important physiological periods may lead to the solution of important scientific as well as economic problems relating to the breeding of sables.

The levels of 17 β estradiol and progesterone in the peripheral serum and in the blood flowing from the ovaries of mature female sables were studied during the periods of mating and ovulation. Blood was drawn directly from females before mating, at 6-12 hr intervals for 48 hr after mating and by laparotomy after 80 to 90 hr. The hormone levels were determined by radioimmunological methods using highly specific antisera.

An analysis of the data revealed relatively high levels of 17 β -estradiol (41.5 pg/ml and 35.6 pg/ml) and progesterone (615.0 pg/ml and 841 pg/ml) immediately before mating and in the first few hours after mating, in ovulating female sables as revealed with or without subsequent laparotomy. In the late ovulating females (first group), there was a second increase in the level of both these sex steroids at 18, 24 and 30 hr after mating. This could be described as pre ovulation or associated with ovulation. In females which did not ovulate late, a second rise in the hormone level during the first few hours after mating was not noticed. In most of the sables of the first group, there was a sharp increase in progesterone concentration 80 to 90 hr after mating and this characterized the beginning of the functioning of the *corpus luteus* (2,324.8 pg/ml). In females of the second group, the progesterone concentration did not rise at this time, though it remained at a high level (606.8 pg/ml). Evidently this was adequate for temporarily suppressing heat. Similar changes were seen in the blood plasma flowing from the ovaries even 80 to 90 hr after mating, but the concentration of these steroids was several times greater than in the peripheral blood.

It may be seen from the above discussion that in sables ovulation sets in the period immediately following the second rise in 17 β -estradiol and progesterone levels, while the duration of ovulation depends on the receptivity of the genital system of a given female. These data confirm the possibility of detecting ovulation and the early stages of gestation (on the fourth day) among sables.

Efferent Nerves in the Liver, Spleen and Kidneys of Mink

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Dissected specimens from 16 mink carcasses were carefully studied following the method of Academician V.P. Vorob'ev

The hepatic plexus is comprised of branches of the dorsal trunk of the vagus nerve and the solar plexus. The latter reaches to the left and right of the hepatic artery; one branch of the dorsal trunk of the vagus also lies there. Together, these branches form the hepatic plexus on the vascular wall, which is composed of two nerve bundles. These surround the arterial wall and are loosely joined to it. Two more branches of the vagus run from the dorsal trunk to the hepatic plexus in the region of the portal fissure. They run along the lesser curvature of the stomach, then pass between the lateral left lobes and the mastoid process of the liver and fuse with the hepatic plexus in the region of the portal fissure. The plexus, along with the corresponding artery and portal vein, enter the portal fissure.

The splenic plexus, composed of two or three branches of the dorsal vagus and five to seven branches of the solar plexus, is located on the splenic artery. It can be divided into the dorsal and ventral portions which split the vascular walls and are loosely joined to them. Together with the splenic artery, the plexus turns into the hilus lienis. From it, five to eight tiny branches extend into the greater curvature of the stomach and one to three branches extend into the greater omentum.

The renal plexus is formed by the nerve branches which extend from the dorsal region of the solar plexus to the right and left of each kidney independently.

The left three to five branches form the left renal plexus on the corresponding artery. This is very loosely joined to the vascular wall and, along with the artery, it runs into the left hilus renalis.

The right hilus renalis is formed by four to six much longer branches of the solar plexus. They are loosely joined to the wall of the renal vein and around the hilus renalis they join with the renal artery. Together with the vessels, the plexus enters the right hilus renalis.

decrease to 123 ± 66 pg/ml. On the 22nd day of gestation, the testosterone concentration rose to 262 ± 40 pg/ml and by the time of whelping, its level dropped to 43 ± 18 pg/ml. During the 14 days of lactation, the testosterone level varied within the range 35 ± 20 pg/ml to 72 ± 39 pg/ml. Progesterone content rose considerably by the 11th day of gestation to $38,800 \pm 3,934$ pg/ml and remained at that level until the 14th day. Later, it decreased steadily until the time of whelping, when it was $1,982 \pm 1,547$ pg/ml. After whelping, the hormonal level ranged from $1,016 \pm 406$ pg/ml to $2,477 \pm 1,727$ pg/ml.

Thus, variations in the concentration of the main sex steroids in the serum plasma of blue foxes have been studied in detail for the first time during their reproduction and gestation periods, and their role in these processes has been demonstrated.

VARIABILITY IN THE MORPHOPHYSIOLOGICAL CHARACTERISTICS OF AMERICAN MINKS UNDER WARM CLIMATIC CONDITIONS

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Environmental factors greatly affect the growth of animals. The most important among these are temperature, humidity, light and feed. The authors studied the effect of warm climatic conditions and feed on the morphophysiological variability of American minks reared on the Amu Darya fur farm.

In 1967, American minks of standard color were imported from the Beregovo fur farm in Kaliningrad district. At the time of import the average weight of males ($n=50$) was 1,355 g and body length 42.5 cm. The corresponding values in females ($n=50$) were 830 g and 33.3 cm. After seven or eight years (1973 up to 1975), the average weight of the males ($n=40$) was 1,100 g and body length 38 cm; in females ($n=40$), the corresponding values were 700 g and 31 cm. This suggests that noticeable changes had taken place in their external characteristics in the course of acclimatization. Investigations of absolute weight and size of internal organs in the American minks under study showed that, in comparison to imported ones, the animals reared in Karakalpak tended to be lighter in the weight of heart, lungs, liver, kidneys, spleen and intestines. The relative indices of internal characteristics showed insignificant statistical differences. However, significant differences were observed in the size of pelts. The authors established that on the Amu Darya fur farm, over a period of five years (1970 through 1975), 21% of the pelts were extremely large, 44.6% were large, 44.6% medium and 31.9% small. The corresponding values of pelts produced on the Biryulinsk fur farm in the Tatar Autonomous Soviet Socialist Republic were 9.3, 46.7 and 1.7%. On the Reinsink fur farm in Moscow district in 1968, these values were 23.4, 48.8, 20.8 and 2.2%, respectively.

From December 1973 up to 1975, morphological investigations were carried out on the blood: the concentration of hemoglobin and the number of erythrocytes and leukocytes were determined. Twenty young and 20 adult animals of both sexes were covered in the analysis.

It can be seen from the table that the concentration of hemoglobin and the number of erythrocytes and leukocytes are lower in the minks reared on the Amu Darya commercial farm than in the animals from the experimental station in the Karelian Autonomous Soviet Socialist Republic (Ivutynnik).

MICROSTRUCTURE OF THE INTESTINAL NERVES IN MINK

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A study of the nerves of the intestinal wall in minks was carried out on six animals by the impregnation method of Bil'shovskii-Gros

The intestines of minks are endowed with an abundant nervous network, which penetrates the entire thickness of the intestinal wall forming a multi-layered plexus nervous located in the layers between the intestinal membranes. The plexus spreads throughout the entire intestine and consists of three layers: subserous, intermuscular and submucosal.

The *subserous nervous plexus* is located under the serous membrane of the intestine deep inside the longitudinal muscular layer. The plexus is made up of thin and straight bundles of nerve fibers which form a sparse network that extends along the length of the intestine. The ganglia are loose and have a few cells. No special differences were observed in the structure of the subserous plexus in different sections of the intestine.

The *intermuscular plexus* lies between the longitudinal and circular muscular layers. It is made up of large bundles of nerve fibers that form a prominent dense network, extending somewhat along the length of the intestine. The plexus is rich in nerve cells, the number of these in the ganglia can vary from a few cells to several dozen. Particularly large bundles of intermuscular plexus, which have large ganglions containing numerous cells, are seen in the iliocecal section of the intestine. Evidently, the extremely rich intra-muscular nervous plexus in this region has an important function, i.e., it serves as a reflexogenic zone and the point of transition from one functional section of the intestine to another. The general plan of the structure of the intermuscular plexus is the same in all of the intestinal sections. However, the most extensive plexus is seen in the duodenum.

Cells of Dogel's second type predominate in the ganglia of the intermuscular plexus. The ratio of the first to the second type of these cells along the length of the intestine corresponds to Academician Laverent'ev's scheme (1931).

The *submucosal nervous plexus* is located in the submucosa layer of the intestinal wall. It is made up of nerve bunches which are thinner than those in the intermuscular plexus. Some of these nerve bunches run independently while others run along with the blood vessels. The bundles of nerve fibers in the submucosal plexus are finely coiled and probably represent the reserved length of the nerve bundle when it is stretched during intestinal movement. The ganglia of the submucosal plexus are small, with few cells, mostly of Dogel's second type, unipolar cells are also present.

SOME FEATURES OF REARING AMERICAN MINKS IN THE KARAKALPAK AUTONOMOUS SOVIET SOCIALIST REPUBLIC

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In 1957, 100 American minks (75 females and 25 males) were brought to the Amu Darya fur farm from the Tatar Autonomous Soviet Socialist Republic. In the very first production years the average yield of kittens was 3.8 and the sale price per pelt was 30 rubles 40 kopeks.

The initial experiments on rearing American minks under conditions of a warm climate gave encouraging results.

In subsequent years, in order to raise the population of the main herd and to freshen the blood, new batches of animals were imported from various fur farms in the country.

The main indices of the productivity of the Amu Darian ondatra fur breeding farm in rearing minks in recent years are shown in Table 1.

Table 1 Main indicators of rearing minks in Amu Darya fur farm

Indicator	Year						
	1970	1971	1972	1973	1974	1975	1976
Number of pelts dressed	6 992	5 358	8 111	8 219	10 400	10 300	9 400
Cost, rubles	38.6	39.6	36.6	35.7	35.3	37.1	41.2
Average cost realized, rubles	39.7	40.1	42.0	40.7	41.6	42.1	41.6
Yield of kittens	3.5	4.0	4.5	3.7	3.8	4.0	3.7

From the experience of the Amu Darya fur farm, it may be concluded that the breeding of fur bearing animals is possible under the warm climatic conditions of the Karakalpak Autonomous Soviet Socialist Republic.

In the near future the lowlands of Amu Darya will become one of the leading regions for fur farming in Uzbekistan. An essential precondition for the development of this industry is the availability of cheap animal and plant feeds. The republic has immense potential for further expansion and for improvements in the profitability of fur farming. This potential lays in improvements in the quality of fur produced, in the reproduction level of the animal population and in the complete utilization of the cheap meat and fish feeds available in the republic. As a result of these favorable conditions, the population of farm-bred animals could be raised by two to three times in the coming years.

Table 1 Morphological pattern of the blood of American minks (n=80)

Age	Sex	Hemoglobin, percentage	Number of erythrocytes in 1 cu mm in millions	Number of leukocytes in 1 cu mm in thousands
Adults	Male	$\frac{93.6}{96.0^*}$	$\frac{7.17}{8.3}$	$\frac{3.83}{6.55}$
	Female	$\frac{91.8}{103.5}$	$\frac{7.46}{8.5}$	$\frac{4.44}{6.71}$
Juveniles	Male	$\frac{94.8}{102.0}$	$\frac{6.77}{—}$	$\frac{4.56}{—}$
	Female	$\frac{99.6}{108.0}$	$\frac{7.32}{—}$	$\frac{4.25}{—}$

*The data of N N Tyutyunnik (1971) are shown in the denominator

1971) Intraspecific differentiation in minks during their acclimatization to warm climatic conditions can be clearly seen in their growth, development and reproduction (Zhollybekov, 1970)

The differences among minks reared under different ecological conditions are evidently associated with the effect of the warm climate and the quality of feed (fish constituted nearly 70% of the feed ration on the Amu Darya fur farm)

between the characteristics, without taking into consideration the determinant factor, still does not guarantee the stability of this association. When examining different groups of animals, the association between heterogeneous characteristics, though greater in absolute terms than the association between homogeneous characteristics, often decreases from a value close to unity to practically nil and more often even changes its sign, this being statistically significant.

The 'moving level' method of P.V. Terent'ev yields results similar to those obtained by factorial analysis. Nevertheless, it has been demonstrated that factorial analysis is far more effective in isolating stable relationships.

METHODOLOGICAL ASPECTS OF ISOLATING INFORMATIVE AND RELIABLE INDICES IN BREEDING

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The selection of animals based on economic considerations is sometimes difficult. In such cases, it is possible to use an ancillary characteristic which would help alter the main feature in the offspring in any desired direction. A necessary condition for the success of such a selection is the stability of the relationship between these characteristics. In psychology, while solving such problems, the factors which help 'reliable' (i.e., stable in time) determination of the values of the main parameters are called 'reliable' in relation to the latter. It is necessary that the main parameter be evaluated correctly, so that the determinant is 'informative' relative to the main factor.

This paper presents the results obtained by an analysis of the stability of the relationship among various morphological characteristics of the wood marten, and applies those in resolving the problem of choosing the characteristics for purposes of selection. The linear coefficients of correlation (r_{xy}) were determined on the basis of the results of 27 measurements in 202 animals. Further, the animals were divided into 12 groups consisting of animals of the same sex, age and point of catch. Factorial analysis was used, its purpose being to isolate certain parameters ('factors'). It is usually difficult or impossible to measure these parameters directly but, nevertheless, from the mathematical viewpoint, they represent the 'original causes' giving rise to the values being measured. The number of factors vitally influencing these measurements has been determined. The degree of association of each parameter, for a group of animals and for a given animal, has also been determined.

When selecting the animals, the characteristics used were such that each of them had been fairly adequately explained by the constant group factors (criterion of homogeneity of the characteristics). An analysis of this material showed that such associations were significantly more stable than the relationships between characteristics with different factors. This is confirmed by the fact that the evaluations of relationships between characteristics with factors which are homogeneous, compared with those which are not, show a significantly low percentage of variations in the values of r_{xy} and a significantly low scatter of the values.

It has been demonstrated that a near-maximum value of association

of A- and B cells in them

In the interlobular connective tissue and in the parenchyma of the pancreas there are often ganglia surrounded by connective tissue capsule and containing large nerve cells. The latter are more often found along the periphery of the ganglia. Sometimes neuroinsular islands surrounded by a distinct capsule are encountered. Stray nerve tissues are seen in some pancreatic islands.

Depending on their diameter, the bile and efferent ducts of the pancreas are covered by either cuboidal or prismatic epithelial portions of the pancreas. In the apical terminal portions of the epithelial cells of ducts there are neutral and traces of acidic mucopolysaccharides. In the walls of medium and large bile and efferent ducts there are pocket-like diverticula, the significance of which has not yet been understood. The mucous membrane proper of the ducts consists of fibrous connective tissue.

The mucous membrane of the gallbladder in fur-bearing animals forms complex folds which are higher and more complex in minks than in silver black and blue foxes. The gallbladder is covered by a single layer of prismatic epithelium. In the apical terminal portions of cells there are neutral and acidic mucopolysaccharides. In the mucous membrane proper of the gallbladder in minks there are often serous glands and in minks and silver-black foxes there are subepithelial lymph nodules.

Thus, in the tissue structure of the liver and pancreas of the animals under investigation there are certain specific and functional differences, which should be kept in mind during diagnostic investigations of the animals.

COMPARATIVE HISTOLOGY OF THE LIVER AND PANCREAS OF FUR-BEARING ANIMALS

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The liver and pancreas of 46 standard minks, 46 silver-black foxes and 46 blue foxes aged 7 to 8 months were studied by histological and histochemical methods.

The general principles and specific characteristics of the structure of these organs were studied. The livers of minks, silver-black foxes and blue foxes have a lobular structure and weakly developed interlobular connective tissue. The organ is covered by a thin but dense connective tissue capsule. The hepatic cells in the lobes are situated radially in two rows of bands forming hepatic cords. Between the cords there are well-developed sinusoidal capillaries. The hepatic cells are polygonal in shape and their nucleus is circular. Binuclear tissues are often found in blue and silver-black foxes, but these are not seen in minks.

The glycogen level of the hepatic tissue varies in relation to the physiological state of the animal. In well-fed minks (within an hour of feeding), the cytoplasm of the hepatic cells contains more glycogen than it does in under-fed animals. The glycogen concentration in these well-fed minks is even greater, while only traces of glycogen are noticed in under-fed animals (24 hr after feeding). Glycogen consumption starts in the hepatic cells in some lobes located around the central vein, while in others it starts from the periphery of the lobe.

The pancreas of fur-bearing animals is compact. The left and right lobes and the head can be distinguished in it. In silver-black and blue foxes, the pancreas is similar to that in dogs, while in minks it is more narrow and does not have a distinct process in the right lobe.

The exocrine portion of the pancreas consists of secretory sections and intercalated and efferent ducts. In the homogeneous zone of the secretory cells there is more ribonucleic acid. In under-fed animals, the height of the pancreatic cells and the zymogenic zone in them are greater than in well-fed animals.

The island of Langerhans in the pancreas of fur-bearing animals varies in size and shape and is situated unevenly in the parenchyma of the lobes. Further, there is a definite pattern in the size of the islands in different lobes of the pancreas. The largest island is found in the left lobe, the smallest in the head and small ones in the right lobe. Islands of Langerhans have no connective tissue capsule. No definite pattern has been found in the location

farm commercial characteristics can be used in breeding groups to evolve new lineages

The advantages of such a reorganization of breeding operations are as follows: it is simple and economical—a small population of selected animals yields positive results in a large herd, close breeding is completely avoided, the effect of heterosis is put to good use, and extensive breeding work is concentrated in the pedigree groups.

The suggested system can be used for any species of animals on any size farm, for inter-farm specialization, for intra farm specialization and within individual brigades or divisions.

On any given farm, the introduction of these breeding methods would ensure optimum conditions for raising a highly productive pedigree, well adapted to the local living and feeding conditions.

ORGANIZATION OF BREEDING OPERATIONS

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With the development of large, specialized fur farms, difficulties arise in the organization and correct execution of breeding operations. The systematic introduction of new pedigree animals facilitates selection in a herd and reduces the need for large herds of pedigree animals selected for specific purposes. At the same time, the possibilities of enhancing the output of a herd by resorting to heterosis (hybridization) are not utilized adequately, this shortcoming can be rectified only by replacing the old animals periodically.

The system of animal breeding adopted, when the composition of the main herd includes a pedigree nucleus and receiver animals, cannot adequately ensure the required level of progress for the growing animal population of the consumer cooperative farms in Byelorussia. Therefore, some changes are proposed in order to improve the organization of breeding operations. The pedigree animals are divided into three separate groups (nongenetic), each consisting of animals with the best phenotype for the population of a given group (tentatively called groups A, B and C). The remaining animals are divided into two separate groups (farms, tentatively I and II). Depending on the population of a herd, each farm may have several independent commercial units (brigades and divisions).

The selection of pairs within the pedigree groups is made on the basis of mutual compatibility with respect to the individual farm and its commercial characteristics. The young of these animals are used to make up the main herd of pedigree groups and the breeding nuclei of commercial brigades. Further, the females from group A go into the breeding nuclei of farm I, the males here, however, are from group B. On the other hand, females of group B and males of group A go into the pedigree nuclei of commercial farm II.

The purpose of the pedigree nuclei of commercial brigades is to obtain females by mating two populations which are used to make up females in the production herd of commercial brigades. Males from breeding group C are used to make up the herd of males on commercial farms I and II.

Consequently, a commercial juvenile which has originated from three populations has enhanced reproductive capacities. Crossbreeding and genetically controlled mating promote heterosis. Animals with outstanding

degreased pelts This may be explained by the thickening of the skin tissue which occurs when a significant amount of capillary moisture is removed from between the fibers

A 12 hr storing of the pelts showed almost no change in size (increase was only 0.1–0.2%) On rolling in wood shavings on the flesh and hair sides, the pelt area (of males as well as females) increased correspondingly by 1.8 and 3.2% due to the moisture of the tissue

Thus, during preliminary processing, there is some reduction in the size of pelts Compared with the pelts as removed from the carcass and not degreased this reduction was 7.5% in the case of male pelts and 9.7% in the case of female pelts

The shrinkage of pelts during finishing has also been investigated It was found that dressed pelts were smaller than the unfinished raw ones, which has undergone all of the preceding stages of preliminary treatment This reduction was 6.3% in the case of male pelts and 10% in the case of female pelts The total reduction in the size of mink pelts in the semifinished state, compared to the undressed, steamed and nondegreased pelts, was 15% in males and 17% in females

The moisture content of the pelts after drying greatly affects the variations in pelt size and quality Underdrying of the pelts during preliminary treatment, as per standard practice, results in less shrinkage since the pelt area decreases as the amount of moisture removed from the skin increases

During drying and rolling on the flesh and hair sides of pelts, it is advantageous to bring up the moisture to a level approaching the normal temperature pressure conditions, i.e., to roughly 12–14% In this event the moisture content of the skin tissue and hair decreases insignificantly on storage and hence variations in the pelt due to shrinkage, deformation, etc., are minimized

CHANGES IN THE NATURAL PELT SIZE OF STANDARD MINKS DURING PRIMARY PROCESSING

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Pelts are evaluated on the basis of their size and hence the index of size is important in fur farming. It is well known that the size of pelts depends on the technology of their preliminary processing, but the range of variations in this characteristic during different stages in the processing of mink pelts has not been studied.

The authors studied the pelts produced by the Vyatka fur farm under the experimental conditions of the workshop of the All Union Scientific Research Institute of Game Management and Fur Farming and in the Belka factory.

They determined the variations in mink pelt size during drying, rolling on the flesh and hair sides and dressing of the semifinished product. The results are shown in Table 1.

Table 1 Variations in the pelt size of minks during different stages of treatment

State of pelt in each stage of treatment	Pelt area sq cm	
	Males, $M \pm m$	Females $M \pm m$
As removed from the carcass	1,181.2 \pm 6.1	857.5 \pm 1.8
Degreased on the flesh side	1,103.9 \pm 3.2	808.8 \pm 1.4
Dried	1,041.1 \pm 1.7	770.3 \pm 0.7
After stocking	1,048.2 \pm 1.6	768.2 \pm 0.8
After rolling on flesh and hair sides	1,067.0 \pm 3.0	793.3 \pm 0.6
Made into semifinished products	1,001.2 \pm 1.3	711.0 \pm 0.1

Investigations showed that the pelt size varied significantly depending on the stage of treatment. After degreasing of the skin tissue, the pelt size decreased approximately 6-7%. The reason for this has not been investigated. Possibly, the layer of subcutaneous fat impeded the elastic properties of the skin tissues and on removing it during degreasing, the tissue became thin. As a result the pelt shriveled somewhat.

In stages of preliminary treatment such as stretching and drying, the pelt size of males as well as females decreased 5 to 6% in comparison with

Table 1. Variations in the moisture and fat contents of the hair coat during different operations in the preliminary treatment of pelts

Operation in the preliminary treatment of pelts	Moisture content, %	Fat content, %
Steaming	17.2 ± 0.80	29.4 ± 0.80
After drying	6.3 ± 0.70	29.7 ± 0.82
12 hr after soaking	6.0 ± 0.21	29.4 ± 0.87
After rolling on flesh side	12.0 ± 0.56	10.3 ± 0.76
After rolling on hair side	10.0 ± 0.82	3.0 ± 0.20

(about 32% in some pelts) during the processes of skinning from the carcass and degreasing of the skin tissue

During processes such as drying and stocking, the fat content of the hair coat remains almost unchanged. On rolling the pelts in moistened shavings, about 90% of the fat is removed from the hair coat and its content does not exceed 3% during the following stage of preliminary treatment, i.e., rolling on the hair side. Thus, the investigations carried out established that the hair coat of undressed mink pelts intended for trade should contain not more than 12% moisture and not more than 3% fat.

HYGROSCOPICITY AND FAT CONTENT OF THE HAIR COAT OF STANDARD MINKS

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Among the complex characteristics of pelts, one of the most important, in our view, is the ability of the hair coat to hold surface moisture and fat. It does this by means of its capillary action and porous structure (the presence of scales on the hair surface).

It is known that an excess or a deficiency of moisture and fat in the hair coat of fur bearing animals adversely affects its characteristics and its commercial value. As a result of excessive degreasing or dehydration, the hair coat becomes dull, dry and brittle. According to the data given by I P Stefanovich (1971), the breaking strength of the hair decreases due to insufficient fat. N L Loseva and Z V Borisova (1972) established that the wear resistance of hair depends on the fat content.

Excessive moisture in the hair leads to mold on the pelts and the growth of other putrefying micro organisms. According to the standard specifications for the main types of dressed pelts (of Karakul sheep, rabbits and minks) the fat content of the hair coat should not be more than 2% and the moisture content should not be more than 12%. No special investigations have been carried out for standardization of the fat and moisture contents of the hair coat of undressed pelts of fur bearing animals. The purpose of the present investigation is to arrive at rational values for the optimum moisture and fat contents of the hair coat of undressed mink pelts and also to establish the changes in these indices during different stages of preliminary processing.

Pelts of minks from the Vyatka fur farm served as the test material. Drying, soaking and cleaning operations were carried out in the experimental workshop of the All Union Scientific Research Institute of Game Management and Fur Farming. Quality control of the pelts was regulated by organoleptic, physical, mechanical and chemical methods. The results of these investigations are shown in Table 1.

The hair coat of steamed pelts contained about 18% moisture. About 35% of the entire moisture had been removed in the drying process. During stocking, the hairs gather an insignificant amount of moisture and after rolling on the flesh side, the moisture content increases noticeably (about 13% in some pelts). On cleaning (rolling on the hair side) the moisture again decreases (about 10% in some pelts 8-12%).

As far as the fat content is concerned, the hairs become excessively fat

animals. The white Headland mink surpasses the standard mink in metabolic rate, but is inferior in systolic rate and respiration. The rate of metabolism and the intensity of thermal regulation are invariably higher in summer than in winter.

In an artificial environment, along with a general increase in body size (as a result of artificial selection for this feature), there is also a proportional increase in the organs associated with digestion and excretion, i.e., the intestine, kidneys and liver. However, the organs associated with the extraordinary efforts of the organism during muscular activity and various 'shock' states, i.e., the heart and lungs, retain their original size, but become weaker.

The adaptive morphological changes and physiological functions, especially the behavior toward man noticed in American minks in a new environment, reflect the specific conditions of that particular environment and the way of life of the animal under these conditions. These changes lead to domestication and are based on the modification as well as the mutational variability of a species.

ECOLOGY OF MINKS UNDER CONDITIONS OF DOMESTICATION

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The ecological characteristics of a species are the results of adaptive evolution in its natural habitat and environment. These are expressed by the degree of response of adapted behavior to morphological, physiological and intrinsic behavioral characteristics. The artificial habitat and the environment of fur-bearing animals reared in pens are essentially different from the biogeocenosis surrounding the animals in nature, though many abiotic or even biotic complex factors remain almost unaltered. Of utmost significance are the absence of natural selection in regard to important biological characteristics, and the origin of natural selection in regard to characteristics which are biologically insignificant or even adverse. As a result, the 'organism, population and environment' system is destabilized and the wild form of a species is transformed into a domestic form.

The microclimate in a pen or cage is formed under the influence of the prevailing climatic complex, the agricultural activity of the breeders and the behavior of the animal itself. The active nest-building and incubational activities of the parents in the period of raising the offspring are often of decisive importance. The adaptive behavior of the animal at this time, as well as throughout the other periods of its life and its annual cycles, is a powerful source for controlling thermal regulation in the pen and maintaining the thermal homeostasis of the organism.

The physiological and behavioral mechanisms of thermal regulation, metabolic rate, cardiac and respiratory function and body temperature evolve during ontogeny according to the genetic code of the individual's growth and development, irrespective of the specific environmental conditions. The establishment of thermal regulation and homoithermy in American minks takes almost 1.5 months, during which time the kits are exposed to a reversible stupor from cold; the incubating female is a necessary requisite for their normal growth and development.

Adult minks possess a high intensity of chemical thermoregulation (3.0-3.5% per degree), the absence of thermoneutral zones, the critical point at 30-35° and the presence of vital seasonal, sex-wise, genotypic and zonal (population) differences. The females have a higher metabolic rate, much higher thermal conductivity of the fur and a greater thermophilic condition than the males. The animals from Karelia and Magadan are characterized by more stable body temperature and accelerated respiration than Kuban'

DEGREE OF HERITABILITY OF FERTILITY AMONG BLUE FOXES

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The proportion of sterile or poorly fertile animals is as high as 40–50% or more in herds of blue foxes. Suitable selection is essential for enhancing fertility. The degree of heritability of this characteristic predetermines the method of selection and its ultimate results. Therefore, this feature was studied among blue foxes on the Vyatka state fur farm from 1968 to 1976, using 3,613 pairs of young daughters and mothers of different ages including 805 young mothers, 2,557 two to four years of age and 251 five to seven years of age.

These investigations showed that reproductive capacity and low fertility do not decrease as the animals get older. The percentage of such females varied in different years from 38.5 to 50.5. The highest reproductive capacity was exhibited by daughters of five- to seven-year old mothers; among these daughters, the level of nonreproductive females was the lowest (23.9%) and the level of females with a moderate or high yield of cubs was the highest (63%).

The heritability coefficient of fertility for different groups of young mothers was invariably positive and varied from +0.14 to +0.58, it was somewhat lower and sometimes negative (it varied from -0.20 to +0.22) in two- to four-year-old females, and it was negative in four cases out of nine (it varied from -0.82 to +0.48) in five- to seven year old females. For the nine-year data on the whole, the coefficients were 0.28, 0.08 and 0.12 respectively.

The heritability coefficients of fertility, as well as analysis of the inheritance characteristics of fertility in relation to the fertility level in females of different age groups, showed that the group of young females with excellent breeding features contained highly fertile animals. The group of two- to four-year-old females comprised animals with moderate fertility and a comparatively high number of fertile animals, while the group of five- to seven-year olds consisted of moderately fertile, moderately less fertile and moderately more fertile animals. The least to be influenced by the external conditions were the two- to four-year-old females. To increase the reproduction rate and carry out selection for constitutional stability, it is desirable to raise the proportion of five- to seven year-old females in a herd.

THERMOREGULATION IN COYPUS REARED WITHOUT WATER IN SUMMER

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Coypus have been successfully acclimatized in many southern regions of the USSR. The practice of rearing them without water in pens and cages is very much in vogue. The low productivity of these animals in captivity is often explained by their poor thermoregulation and poor adaptation to living without water. The available information on the thermoregulation of coypus is contradictory (Slonim, 1952, Kuz'mo, 1966, Sultanov and Alimukhamedov, 1966, Sultanov, 1968, and Sultanov and Shatalina, 1968) and this necessitated the publication and discussion of the available data on this subject.

Experimental work was carried out during the summer of 1965 on the Severinsk state fur farm (Kuban') on four- to six-month-old males of standard type weighing 4.2-4.5 kg. The metabolic rate was determined by pneumatic cameras (Slonim, 1952) after exposing the animals to different temperatures within the range of zero to 35° after 2-hr intervals. The body temperature was measured rectally and at 11 points on the skin surface simultaneously. The respiration rate was also measured.

Chemical thermoregulation covered the range between zero and 20°, its intensity being 2.1-3.3% per degree. The critical point lay around 20°, the 20-30° zone was thermoneutral and its metabolic rate was 0.60 ml O₂/g/hr with a respiratory coefficient of 0.65-0.68.

There was a positive correlation between the respiration rate and the external temperature in the range 15-35°, but without signs of polypnea. The role of respiratory rhythm in thermoregulation was of little importance.

The temperature at the center of body and on the skin surface showed a positive correlation with the external temperature throughout the temperature range under investigation. It was characterized by a high degree of variation. The rectal temperature varied from 33.2° at 0° to 36.7° at 35°. But the vascular changes in the skin were strictly confined to the distal extremities and tail in relation to physical thermoregulation, regression elsewhere on the body surface was in the same range as in the rectum. At high temperatures 33% of the heat flow passed through the feet and tail, which comprise less than 10% of the body surface, while at low temperatures only 5% passed through.

The differences in the thermoregulation pattern of coypus taken from different climatic and geographic regions of the USSR reflect physiological polymorphism and population variability under influential adaptive and acclimatization factors.

bearing animals in pens. After tests at the Vyatka fur farm which yielded positive results, the equipment was presented for use on 12 cooperative and state farms and at other institutions.

The Coordination Committee of the Ministry of Agriculture, USSR, handed down a resolution on the report of the All-Union Scientific Research Institute of Game Management and Fur Farming on the prospects of farm rearing new species of wild fur bearing animals with the purpose of enlarging their range and improving their fur quality. In accordance with this resolution a study was started in 1972 on the possibilities of farm rearing Kamchatka red foxes, which are the most valuable of the wild foxes found in the USSR.

In these efforts, hybridization of the red Kamchatka fox with the local silver black foxes from the Vyatka fur farm was extensively resorted to. The results of crossing the test foxes revealed the genetic diversity of the herd of silver-black foxes reared on the fur farm of the Institute.

During the period of our work, two types of silver black foxes were identified. The domination of red coloration, established as a result of crossing the Kamchatka foxes with silver black foxes of the first type, rapidly yielded red Kamchatka foxes for inbreeding.

The second type of silver-black foxes, which on mating with the red Kamchatka foxes yielded gray foxes, was used to produce juveniles of intermediary colorations for their furs.

At present, the Vyatka fur farm has foxes of the third and fourth generations of dissipative mating, as well as those obtained as a result of inbreeding of wild red Kamchatka foxes.

The offspring of red Kamchatka foxes reared in pens are characterized by a high vitality, as adults they are large and have high quality fur. At the 1975 and 1976 Leningrad fur auctions, the pelts of discarded and slaughtered red and gray foxes fetched 36% higher prices than the best silver black fox pelts. The pelts of the red Kamchatka foxes reared on the Vyatka fur farm attracted the attention of fur farms because of their dense hair coat, unusually beautiful color, and large size (Pastushenko, 1976).

The market survey and breeding laboratories of the All-Union Scientific Research Institute of Game Management and Fur Farming prepared the technical specifications for undressed pelts, of farm bred Kamchatka red foxes, hybrids and gray foxes and specified an economic pricing policy with suggestions for improving their breeding in pens.

The main obstacle in the evolution of new species to increase the range of pelts of indigenous farm-bred, fur bearing animals is the lack of encouraging prices.

The investigations of the All Union Scientific Research Institute of Game Management and Fur Farming show that, when the above lacuna is rectified, new varieties of white foxes and ferrets will be quickly added to the list of farm bred fur-bearing animals.

INTRODUCTION OF RESULTS OF SCIENTIFIC STUDIES FOR INCREASING THE VARIETY OF FARM BRED FUR-BEARING ANIMALS

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As a result of special genetic studies on the colored forms of coypus at the Vyatka state fur farm of the All-Union Scientific Research Institute of Game Management and Fur Farming, two new types of these fur-bearing rodents—snow and pastel—were produced

The Kirov snow coypus, unlike the white Italian and Azerbaijan ones, have pure white guard hair and underfur throughout the body. In 1970, the first pastel coypus were obtained on the experimental farm and their color came close to that of the well known pastel minks. The hair coat of pastel coypus is brown with a distinct blue shade and blue underfur. At present, pastel animals in dark, moderate and light shades have been evolved on the Vyatka fur farm.

As a result of work carried out over several years in rearing coypus with new colors by inbreeding, herds of pure snow and pastel coypus have been raised on the Vyatka fur farm.

The Kirov snow and pastel coypus have gained immediate popularity among the fur farmers of the country. In 1968, snow coypus were exported to the Rumanian People's Republic.

In 1967, the Kirov snow coypus were awarded a certificate at an Exhibition of the Achievements of the People's Economy of the USSR. In 1973, a cloak made of snow coypu pelts raised on the Vyatka fur farm was awarded a gold medal at the Leipzig autumn fair.

From 1971 up to 1976, snow and pastel coypus raised on this farm were sent out for breeding to 60 regions located in different climatic zones of the country. Over 40% of the pups were supplied to the procurement office of the consumer cooperative union for use by amateur breeders.

In recent years, ancillary farms specializing in rearing snow and pastel coypus have been organized at the Zatonsk experimental-demonstration farm controlled by the Gorky regional farm and the 'Pamyat' Lenina' collective farm in Kuibyshev district. The object of these was to develop large reserves of coypus with these new color shades.

As a result of investigations to improve the profitability of rearing coypus under the conditions in Kirov, equipment was devised to rear these fur-

DEVELOPMENTS IN COYPU BREEDING

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In spite of long-term breeding, the production of coypu pelts and their dressing by state organizations has not grown proportionally as can be seen from the following data (average for five-year periods, in thousands)

1946-1950	8 3	1961-1965	139 6
1951-1955	33 2	1966-1970	153 8
1956-1960	103 2	1971-1975	108 3

Poland, with a much lower population, produces over a million coypu pelts a year

Under the rapidly growing conditions of farm bred fur production, the specific proportion of coypu pelts among the finished fur products decreased for the country as a whole

	1960	1970	1975
Dressed animal furs, % 1960 level	100 0	430 0	737 0
Specific proportion of coypu pelts (%)	1 6	0 43	0 34

The prevailing position is due to the inadequate attention paid to the rearing of coypus and to inadequate economic incentives as compared to the other products of fur farming (Table 1)

Table 1. Indices of pelt evaluation

Index	Unit of measurement	Mink (1)	Coypu (2)	Ratio of 2 1
Pelt area of large size	sq dm	8(7 3-8 8)	22(20-24)	2 75
Cost of dressing a pelt				
a) large sized first grade normal brown pelt	rubles	47 9	21 00	0 44
b) average for 1975	rubles	45 37	12 34	0 27
Cost per sq dm of pelt				
a) in the raw condition	rubles	5 98	0 95	0 16
b) in the dressed condition	rubles	9 16	2 64	0 29
Wear resistance of fur article	as percent of otter pelt	70	40-50	0 57-0 71

A total of 145 5 thousand coypu pelts were dressed in 1975. These included 46 7 thousand pelts supplied by the state farms, 23 3 thousand supplied by the

REARING COMMON OTTERS IN CAPTIVITY

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The growing demand for fur goods in turn enhances the demand for a greater variety of fur products. One method of solving this problem is to rear new species of valuable fur bearing animals in pens. Of particular interest in this direction are common otters (*Lutra lutra*). According to P B Yurgenson (1932), the otter possessed all of the requirements for becoming a highly profitable object of commercial fur farming but no experiments in this regard have yet been undertaken.

One of the problems confronting us was to study the possibility of rearing otters in pens. For this purpose, the authors used wooden, two roomed, warmed nests with wire mesh enclosures 1.5 sq m in area. The floor of the enclosure was raised off the ground and equipped with tipping water troughs as used in the rearing of coypus (Sokolov and Timofeev, 1970). In summer, the troughs were filled with water for bathing and in winter with snow which the otters avidly used for cleaning their hair coat. The otters were fed a ration approved by the Vyatka fur farm for rearing mink stock. The norm was raised in proportion to the weight of the test otters at the rate of 100-150 kcal a day per kg live weight of the animal.

The intake per kg live weight is highest in year old otters and lowest in three-year-olds. The view has been expressed in literature that the otter has a great need for high quality feeds (Yurgenson, 1932 and Vshutsev, 1972). In experiments, the daily feed intake of otters per kg live weight did not exceed 150 kcal while minks [N Sh. Perel'dik (1972)] needed 200 kcal a day of metabolic energy per kg live weight. By one year of age young otters reared in pens had attained the weight of adult animals caught in the wild (Table 1).

Table 1 Weight of otters of different ages

Sex	n	Weight of test otters at different ages in months			Weight of Sakhalin otters caught in the wild (Vshutsev 1972)
		6	10	12	
Female	2	3.5	4.2	4.5	5.5
Male	2	5.7	6.3	7.2	6.4
Average		4.6	5.2	5.8	6.0

These experiments showed that the rearing of otters in pens was possible, especially of those caught at an early age.

HYBRIDS OF BLUE AND SILVER-BLACK FOXES

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The problem of the hybridization of blue and silver black foxes has been engaging the attention of specialists since the very inception of fur farming. Several successful attempts have been made to obtain first generation litters by mating these two species of animals (Starkov, 1941, Cole and Shackelford, 1948 and Wolinski, 1964). However, because of low populations, no one could provide a complete description of the hybrids. On the experimental demonstration farm of the Institute several dozen hybrids were produced over the last few years by impregnating female blue foxes artificially with the sperm of silver black foxes. In this process, the females retained the characteristic fertility of blue foxes.

In the estrous period, the outer sex organs of the hybrid females took on the characteristics of female blue foxes coming into heat, the reflex action of 'immobility' in the presence of males was clearly manifested. The hybrid males exhibited sexual activity. During coitus, normal penis erection was observed in them. However, attempts to obtain second generation hybrids, as well as offspring by mating the female hybrids with male blue foxes and female blue foxes with hybrid males, remained unsuccessful. Histological investigations of the testes showed that spermatogenesis in the hybrids was interrupted in the stage of primary spermatocyte.

Compared with the half sibs from the original species of animals, the hybrid juveniles at six months were characterized by a statistically significant increase in live weight and greater chest circumference behind the shoulders, which shows the favorable effect of heterosis. In regard to the length of head, ears, legs, tail and width of the head, the hybrids occupied an intermediary position between the blue and silver black foxes. In regard to the length of trunk, they were closer to the silver black foxes, being significantly superior to the blue foxes. The relative weights of internal organs, as well as the indices of serum proteins in the hybrids, were similar to the corresponding values in the blue foxes.

Clearly, the characteristics of structure and hair coat in the hybrids of blue and silver black foxes are of utmost interest. In these hybrids an intermediate character of inheritance of the length and thickness of the guard hairs and underfur was noticed. In color, they exhibited significant variations. The extreme variants approached the original forms. On the whole, the hybrids had very distinct brownish shades with lesser intensity of color than the silver black foxes. Guard hairs with a silver halo were detected in

farms of the All-Union Consumers' Cooperative Society and 75.5 thousand pelts supplied by individual and other farms. In the Russian Soviet Federative Socialist Republic, 52,900 pelts were dressed against a plan target of 19,700.

The stabilization of coypu rearing in the public sector, along with other factors, is due to its poor profitability. On farms of the Consumers' Cooperative Society, the production of pelts is unprofitable, particularly on specialized farms. On the Chuisk and Shamkhorsk farms, the level of profitability was -30% (1975). Profitability is high on complex farms and on those which have specialized in breeding light-colored coypus.

An analysis of regional data has shown that pelt production by each farm is several times (3-10) more than what actually goes for dressing. In the market, the price of coypu pelts goes up to 50-70 rubles per piece. Considering the rapidly rising prosperity of the people and the shortage of fur goods, as well as the limited varieties of animal species reared, the state of coypu rearing and the dressing of pelts cannot be regarded as satisfactory. At present, the development of coypu rearing is especially important since the coypu is a phytophagous animal, and more important, its meat is edible. All of the other animals reared for their fur need meat and fish products, which are in short supply because of the dwindling resources of the oceans.

To sharply increase the production and dressing of coypu pelts, it is necessary that:

(a) the price of coypu pelts be raised to at least twice the present level;

(b) the Ministry of Agriculture, USSR, and other departments undertake measures to organize the rearing of colored forms of coypus on state and collective farms, cooperatives and other farms in accordance with the methods worked out by the All-Union Scientific Research Institute of Game Management and Fur Farming and also by specialized farms, by providing the required capital investment for this purpose in the period 1978-1985;

(c) coypu breeding by individuals be rationalized by organizing breeders into a trading group (section), by obligatory purchase of the pelts produced by them, by exempting all categories of amateur breeders from income tax and by energizing the work of the trading groups of local councils and dressing organizations; and

(d) the members of these groups be supplied larger quantities of foodgrain and wire mesh as per contract, and land for raising vegetables and hay should be made available to these groups.

BREEDING BLUE FOXES FOR GREATER BODY LENGTH AND LIVE WEIGHT

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This work was carried out on the Roshchinsk fur farm from 1974 up to 1976. Blue foxes were selected simultaneously for two characteristics: live weight and body length. Groups of large and small animals were formed on the basis of their weight and measurements at the beginning of the year. The group of large animals consisted of those whose weight and length exceeded the average herd index by 0.56, while the small group consisted of those whose index was 0.56 lower than the average herd level.

The weight and body length of the juveniles were assessed at the age of five months. One group consisted of juveniles of large parents with size indices 0.56 higher than the group average.

The juveniles obtained from a homogeneous group of parents with a large body length were in all stages of breeding significantly superior in this characteristic to the corresponding young of small-sized parents. During reciprocal heterogeneous selection of parents, the juveniles obtained occupied an intermediary position with respect to body length. When the parents were selected for their live weights, the young of large and small parents did not show any significant difference in the characteristics of the selected features.

The results of two years of breeding blue foxes to make them heavier and longer simultaneously showed that selection for body length was more effective. The coefficients of heritability (h^2) of body length and weight also point to the greater effectiveness of breeding blue foxes for their body length; these coefficients are equal to 0.19–0.40 and 0.13–0.22, respectively.

The juveniles obtained from long-bodied parents were significantly superior to the corresponding ones obtained from short-bodied parents, even in their weight.

Over a period of three years, the selection of blue foxes to increase their size enabled the body length of five-month-olds to be raised from 62.5 cm to 64.3 cm in females and from 65.5 to 67.0 cm in males. The difference in both cases was statistically significant ($P > 0.999$).

The selection of blue foxes to increase their body length did not adversely affect their reproductive capacity. The long-bodied females were in no way inferior in litter size to the short-bodied females.

There was also no adverse effect on the quality of their pelts. Animals with a long body produced larger (defect-free) pelts than the smaller-sized animals.

all of the hybrids, which confirms that this characteristic should be regarded as a dominant feature. But the specific proportion of guard hairs with a silver halo and the width of the halo are significantly smaller in the hybrids than in the silver-black foxes. The tail of the hybrids was lighter in color than that of the silver-black foxes but the 'type' was transmitted as a dominant feature.

On the whole, the pelts of the hybrids of blue and silver-black foxes were characterized by larger size than those of the blue or silver-black foxes, and they had more luxurious fur and fewer defects. The color of the pelts was better when the hybrids were produced from female silver foxes.

Conclusion

1 The production of hybrids from blue and silver black foxes is possible, and is most successfully achieved by the method of artificial insemination of female blue foxes with the sperm of silver-black foxes.

2 Hybrids, as a rule, inherit to an intermediary degree the characteristics determining the interspecific differences between silver-black and blue foxes. The silver halo and the 'type' are transmitted dominantly.

3 The organization of large scale production of the pelts of hybrid blue and silver-black foxes could be an important factor in increasing the range of farm bred fur products.

CHANGES IN SOME CHARACTERISTICS OF MINK PELTS IN RELATION TO THE AGE OF THE ANIMALS

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Among Russian investigators, changes in mink pelts with the age of the animals have been studied by A P Russkikh (1960), G A Kuznetsov (1961), M D Abramov (1965), L G Utkin (1969) and others. However, the variations in size, weight and thickness of the skin of pelts in relation to the age of the animals have not been studied by these investigators.

The author studied the variations of this property in relation to age using mink pelts obtained from the Vyatka fur farm in Kirov district and the Gulbensk area of the Latvian Soviet Socialist Republic. In all, 382 pelts of kits in 11 age categories (from 20 days to six months) were investigated, using the methods of B F Tserevitinov (1951) and B A Kuznetsov (1952).

The pelt size of 20-day-old kits did not exceed 165 sq cm, their average weight was 13 g, and the thickness of their skin 0.13 mm. As the animals grew, increases in all of these indices were recorded. Between 20 days and 1.5 months, the increases in pelt size and weight were insignificant. But by the age of three months, the pelts had grown by nearly 2.5 times and their weight was double that of the pelts of kits aged 1.5 months.

Starting at three months, the size and weight of pelts steadily but very slowly increased. At the beginning of the fifth month, the size had increased to 65 sq cm and the weight to 109 g. In regard to these indices the pelts of five-month-olds were no inferior to those of the six-month-old animals earmarked for slaughtering.

The thickness of the pelt skin varied less. This property of pelts was directly proportional to the age of the animals and it was also dependent on the season of the year. In the first 1.5 months, the skin thickness increased by 0.05 mm (at the age of 20 days, it was 0.13 mm). In two-month kits (spring-summer period), there was a significant increase in thickness, which can be explained by the active formation and growth of new hairs and by the large reserves of nutrients in the skin that were required for hair growth. As a result of the accumulation of these substances, there was a significant thickening of the skin tissue (Russkikh, 1960 and Utkin, 1969).

From 2-3.5 months, the skin thickness remained almost unchanged. In four-month-old animals there was again a thickening of the skin tissue which could be explained by autumn molting and the formation of winter

Conclusion

1. The selection of blue foxes to increase their size, i.e., their body length, is more effective than selection to increase their live weight.
2. The selection of blue foxes to increase their body length did not adversely affect their reproductive capacity or the quality of the pelts.

PROSPECTS OF USING POLECATS FOR ARTIFICIAL BREEDING

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The fur of polecats is presently in great demand. At the 1976 Leningrad auction, the maximum price for a light colored polecat pelt (39 dollars) exceeded that of martens (31 dollars) and dark brown minks (33.5 dollars, Pastushenko, 1977).

At the experimental farm of the Siberian Division of the Academy of Sciences of the USSR, thorough investigations have been carried out on the biology of different types of polecats, i.e., light colored (steppe), black (forest) and ferret (albino or black polecat). One of the tasks was to raise hybrids of these polecats.

Our experiments showed that the ferret can be crossed readily with the black polecat directly and reciprocally. In direct crossing, female ferrets were mated with male black polecats, while in reciprocal crossing, female black polecats were mated with male ferrets. During direct crossing, the average fertility was double (11 cubs) than during reciprocal crossing (five cubs). The first generation of direct hybrid females had a high fertility (an average of 10 cubs). The reciprocal female hybrids yielded no offspring and resorption of embryos has been recorded. Hybrid males (direct and reciprocal) were fertile. In all of the first generation hybrids, the color black was dominant. In the second generation, Mendelian segregation was noticed.

The production of interspecific hybrids was more complex. Two female ferrets that mated with light colored polecats bore 9 and 11 cubs each. In the first generation, the hybrid females were characterized by a high fertility (an average of nine), while the males were highly polygamous and had prolonged spermatogenesis. The color of the light-colored polecat predominated. In studies on reciprocal mating, a light colored female polecat which had mated with a ferret was dissected on the 22nd day of gestation. This revealed six embryos (which died due to laparotomy).

The hybrids of wild species of polecat, which are probably found in nature, were particularly interesting. The authors produced litters by mating a female black polecat with a male light-colored polecat. Though this female

hair. This period lasted up to five months, after which time the growth of hair ceased and the skin tissue became somewhat thinner.

Thus, the most pronounced increase in the size and weight of pelts, and in the thickness of their skin tissue takes place in the most active growth period of the kits (20 days to 3.5–4 months, Abramov and Utkin, 1964). This phenomenon should be taken into consideration when breeding fur-bearing animals using various zootechnical measures.

STRUCTURE, TOPOGRAPHY AND BLOOD SUPPLY TO THE DIGESTIVE ORGANS OF SABLES

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The carcasses of sables of different ages, collected during the autumn slaughtering on the Pushkinsk state stockbreeding farm in Moscow district, were used for these studies. The method of thin sectioning, measurements, weight, corrosion preparations and x-ray vasography were used in these investigations.

The stomach of the sable is in the shape of a bent sac located in the anterior abdominal region, almost like a segment between the 10th to 13th ribs. The greater curvature of the stomach is turned caudoventrally and reaches up to the 14th rib. The cardinal portion of the stomach is turned somewhat to the left, while the pyloric portion is turned to the right. The capacity of the stomach is 120 to 250 cm³ and its weight is 8 to 14 g.

The small intestine, with a length of 140 to 180 cm and a diameter of 8 to 14 mm, consists of the duodenum, jejunum and ileum. The duodenum runs dorsally under the 12th to 13th thoracic vertebrae, turns in a caudal direction, and then turns to the left in the region of the second-third lumbar vertebrae, without any clear cut transition, it then forms the loop of the jejunum and ileum.

The thicker section, or large intestine, is 15 to 20 cm long and consists of the colon and rectum. Sables do not have a blind gut. Commencing from the right side at the base of mesentery, away from the jejunum the colon transits onto the left side. Later, the colon turns into the pelvic cavity and then into the rectum. No sharp distinction in the transition between the colon and the rectum has been detected.

The liver weighs 32–50 g and consists of six lobes (right and left lateral and medial, quadrate and caudate). The gallbladder is located between the right medial and quadrate lobes. The liver is found posterior to the diaphragm, its lower margin reaching the zone of xiphoid cartilage.

The pancreas weighs 2 to 3.5 g and is 18–24 cm in length. It consists of a head, body and right and left lobes. The left lobe is clearly seen while the right lobe appears to be a continuation of the glandular body. The pancreas is situated in the right hypochondrium along the mesenteric region of the duodenum.

The blood supply to the stomach is mainly through the left and right gastric and gastroduodenal arteries, from which much smaller arteries branch out.

was operated on the 18th day after mating (fertile fetuses were removed from the left horn of the uterus, while the right one was left intact), it successfully gave birth to three cubs. The following year, again, she mated with the same male and gave birth to two more cubs. Hybrids of the first generation were fertile. The female crossed with the light colored polecat and bore seven cubs. A male crossed with two female black polecats and bore seven and eight cubs, and with two female ferrets (litters of four and ten cubs). Hybrids of black and light colored polecats had the same color hair coat as that of light-colored polecats, except that they had a much longer dark portion at the tip of their tail.

In all, 22 type of matings of polecats were observed. These yielded 70 litters and produced large hybrid forms with beautiful fur and high fertility. Among hybrid females there were many mild animals with motherly reflexes, which could be profitably used as excellent mentors, i.e., as trainers of cubs of various valuable fur bearing animals. It should be emphasized that two or even three litters of polecats and their hybrid forms could be obtained annually.

USSURIAN RACCOON—A PROMISING SPECIES FOR FARM REARING

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Farm rearing of Ussurian raccoons, or raccoon-dogs, was in vogue at the end of the 1920s and 1930s. However, in the difficult War and post war years, the rearing of this species ceased (Il'ina, 1952). Investigations carried out over the last decade have shown that the Ussurian raccoon was of average taste and highly fertile, while its fur was in great demand in the international market (Pastushenko, 1977). Its main biological features suggest that it could be widely used for fur farming.

1 The Ussurian raccoon is a polyphagous predator. Along with animal feeds, plant remnants are also regularly found in the stomachs of these animals. Their morphological features (poor growth of canines, flattened molar surfaces, high abdominal index, etc.) also suggest the euryphagy of raccoon dogs. When breeding on farms, they could be given the food left over after feeding the main animal population on the farm.

2 The high ecological adaptability of this species, the vitality of these animals and their ease of handling in captivity are of particular interest. In the winter, their basal metabolism decreases by 25% in comparison with its corresponding level in the warm period of the year (Sokolov, 1949), their body temperature also decreases (author's data). These enable the animals to remain in a state of winter hibernation for a prolonged period (from December to the end of February). During this period, the Ussurian raccoon comes out for feeding only in thawed patches. For the rest of the winter, it survives by utilizing its significant reserves of body fat (up to 25% of its total weight), which are replenished in the autumn.

3 The comparatively early sexual maturity of the animals (8–10 months), the relatively short duration of gestation (60–70 days), and their high fertility (about 13–16 cubs) demonstrate the high reproductive capacity of this species. Moreover, many females of this family of dogs and raccoons lay two litters a year (Korytin, 1974). This phenomenon could be profitably utilized to increase the farm breeding of Ussurian raccoons.

The intestine is supplied with arterial blood through the anterior and posterior mesenteric arteries. The latter then branches out into the ileocolic artery, which is divided into the right colic and ileac arteries. The posterior mesenteric artery is later divided into the left colic and posterior rectal arteries.

The blood supply to the liver is through the hepatic artery which, after entering the portal fissure, divides into three large branches from which much smaller branches radiate.

The pancreas receives arterial blood through the splenic branches and the gastroduodenal and hepatic arteries.

Evidently, in minks, the weaning of a litter in order to induce a second heat should be attempted at a very early stage, roughly before the kits are a week old. Particular attention should be paid to the European mink, which differs from the American mink in its reproduction biology. A relatively short gestation period, a late period of heat and the fact that two litters can be obtained in the same reproductive cycle (Ternovskii and Ternovskaya, 1977) render this species extremely promising for farm-breeding.

THE POLYESTROUS POTENTIAL OF MINKS AND OTHER SMALL MARTENS

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At present, some recognized works (Korytin, 1974 and Tumanov, 1977) have gathered factual data to demonstrate the possibility that the females of many predatory mammals mate and litter twice a year, as has been observed in domestic dogs. This phenomenon is most often observed in martens. It has been pointed out that, in the event of resorption of embryos, birth of dead cubs or their early death, the females of small predators can again go into heat, mate and yield a second live litter.

Zoologists and ornithologists are aware that when the first nest is lost during the period of sexual activity, a bird lays for a second and sometimes even a third time. Poultry farmers gather the eggs laid by the hens and thus stimulate the birds to lay more eggs. By taking advantage of this phenomenon, the females of some fur-bearing animals can be induced into a second heat. Evidently, such a phenomenon is possible in all of the martens, in which prolonged diapause of embryonal development is absent.

By weaning day old cubs and putting them under the care of foster mothers, zoologists D. V. Ternovskii and Yu. G. Ternovskaya, in the summer of 1976, obtained two litters each from female European minks and hybrid polecats and three litters from a female alpine weasel (Ternovskii and Ternovskaya, 1977).

While studying the potential for multiple estrous cycles in martens (Danilov and Tumanov, 1976 and Tumanov, 1977), the authors attempted to determine the maximum possible period within which the young could be weaned away, so that the characteristics of a second estrous cycle are induced in the females.

Observations on a female alpine weasel, whose kits died at the age of 16 or 17 days (birth May 8 and death May 24, 1974), showed that a week after the death of the young, the female was again in a state of estrus, mated and laid a second litter on July 18. At the same time, on weaning 15-day old kits (four in number) from a female European mink (June 1976), only some stray estrous scales were detected in her vaginal smears. She did not mate, with a male for the second time, nor could she be induced into heat. This was true also of two other female American minks caught in the wild together with their broods (experiments made in 1971). The kits of these females were weaned at the age of 15 to 20 days.

the ovaries weighed 35.5% less and the horns of the uterus 17.3% less and at 17 months the difference in the relative weight of the ovaries was 13.5%.

The sulfhydryl groups characterize the rate of metabolic processes (direct dependence). The authors established that, at the ages of 5, 17 and 29 months, the content of SH-groups was 2-15% less in the skeletal muscles and the brain of female and male colored minks, while it was 3-6% more in the tissues of the spleen. A significant difference was noticed in the level of catecholamines, which characterize the state of the sympathetic part of the autonomic vegetative nervous system. On an average, in males of the American palomino type, the level of adrenaline in the tissues of the adrenal gland was 19.5% less and the level of norepinephrine 29.8% less; the corresponding values in the females were 34.6 and 16.8%, respectively.

Thus, the results point out that mutations with respect to the allele K in minks not only change the color of the fur, but also change the structure and function of many important endocrine glands and other internal organs.

PLEIOTROPIC EFFECT OF THE GENES RESPONSIBLE FOR COLOR IN AMERICAN PALOMINO MINKS

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Asdel (1946), Johansson (1956), Butler (1958), D K Belyaev (1958, 1959 and 1961) and others have pointed out that, due to their pleiotropic effect mutations which bring about color changes in the fur are often accompanied by impairment of reproductive properties in the minks. As compared to standard minks, female colored minks have a much later period of heat (Tsepkov, 1962), a longer gestation period (Evsenkov, 1965), a higher activity level of the thyroid gland (Eremeeva, 1964) and a lower estrogen level in the tissues (Fokin, 1970), as well as changes in other internal indices.

The problem in the present investigation was to study the comparative weight of some internal organs and their contents of sulfhydryl groups and catecholamines in standard and colored minks of the American palomino type. The investigations were carried out on 84 clinically healthy minks of different ages and sexes in November and December 1976. The animals were killed by injecting diacetylcholine and the brain, heart, liver, kidneys, spleen, thyroid, adrenal gland, ovaries (testes), horns of the uterus and pituitaries were removed and weighed. Tissues used for determining the SH group and catecholamine levels were placed in liquid nitrogen. The level of the SH group was determined in the skeletal muscle, and in the tissues of the brain, heart, liver, kidney and spleen by the amperometric titration method of Kol'thoff and Harris as modified by Sokolovskii. The content of catecholamines (adrenaline and norepinephrine) was determined in the adrenal gland by the fluorometric method of Matlina and Rahmimova.

The results revealed significant differences in the weight of many internal organs between standard and colored minks, in absolute as well as relative terms. The weight of the thyroid was higher in colored minks: at five months of age, it was 7% higher in females and 47.2% higher in males, the corresponding increases at 17 months were 15.7 and 11.1% and at 29 months 58.6% in males. The relative weight of the adrenal gland at the age of 17 months was 51.7% higher in females and 33.6% higher in males and at 29 months it was 15.3% higher in males. A similar difference was noticed in the relative weight of the spleen. However, the relative weight of the ovaries and horns of the uterus was lower in minks of the American palomino type than in the standard minks. In the colored females aged five months,

of American minks reared in other climatic zones showed no significant differences in the indices of internal organs, with the exception of the weight of the kidneys and lungs and the length of the intestines.

The weight of kidneys and lungs was 45 and 35% less, respectively, and the intestine was 25 cm shorter in the minks of the Angren fur farm than in the American mink reared in Magadan (Segal', 1975). These differences seem to be associated with the excretory, respiratory, and digestive functions of the animals caused by specific climatic and feeding conditions.

Thus, the results of these investigations showed that the deviations from normal of the morphological characteristics of minks reared under warm climatic conditions are insignificant and are of an adaptive character.

SOME INDICES OF INTERNAL ORGANS IN MINKS REARED UNDER THE WARM CLIMATIC CONDITIONS OF UZBEKISTAN

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Mink farming has gained immense popularity in Uzbekistan in recent years. It is known that a high ambient temperature, exceeding the upper limit of the optimum temperature for a given species, causes several morphological and functional disturbances. In this context, a study of the morphological indices of animals during their acclimatization to new ecological conditions would be of interest. Though the internal indices of minks reared in cold and moderate climatic zones have been studied by several investigators, their morphological variability during acclimation to warm climatic conditions has not been studied adequately.

The present study relates to certain morphological characteristics of American minks reared on the Angren fur farm located 100 km from Tashkent. We used eight month old minks which had been reared on ordinary rations in standard sheds.

The period of growth and development of kits coincided with the period of summer heat: the maximum atmospheric temperature in June, July and August varied between 37° and 42°. Throughout the growth period the live weight of kits was under systematic observation.

The general characteristics determined were the weight and body length, weight of heart, kidneys, liver, spleen, pancreas, thyroid and stomach and the length of the digestive tract. The tests were carried out at the time of slaughtering in December 1972.

Significant sexual dimorphism was established with respect to the indices studied. The maximum body weight and weight of internal organs were recorded among males. The body weight of males was $1,635.80 \pm 22.00$ and of females $1,040 \pm 16.69$ g. The body length was correspondingly 46.22 ± 1.29 and 38.07 ± 0.75 cm. The absolute weight of the heart of males was 10.72 ± 0.24 and of females 6.31 ± 0.13 g. The weight of the lungs was 23.51 ± 0.60 and 13.04 ± 0.41 , respectively, of the liver 73.53 ± 1.48 and 15.90 ± 0.73 , kidneys 5.41 ± 0.19 and 3.48 ± 0.06 g, spleen 3.53 ± 0.15 and 2.60 ± 0.10 and adrenal gland 3.43 ± 0.16 and 2.04 ± 0.09 g. The length of the intestine was 161.68 ± 1.46 cm in males and 133.87 ± 1.44 cm in females.

A comparison of the authors' data with the morphological characteristics

SABLES WITH AN ABERRANT COLOR

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An unusual, or aberrant, color of the hair coat is noticed among many species of animals. Among sables, too, there are colored specimens. The author gathered data on colored sables in nature and established the regions where they are seen most often (Monakhov and Cheglakov, 1973). Albinism, melanism, hyperchromatism, etc., represent aberrant types of fur coloration.

The institute carried out a publicity campaign to inform the directors of game farms under the Central Fur Cooperative and to directly inform the hunters of sables, the conditions for catching the animal and the conditions for purchase of colored sables by the All-Union Scientific Research Institute of Game Management and Fur Farming.

In December 1974, a report came from the Khabarovsk region (Komsomol'sk-on-Amur) regarding a catch of the first colored sable which was turned over in good condition to the Vyatka fur farm of the All-Union Scientific Research Institute of Game Management and Fur Farming. The sable was a male born in 1974. Later, he acclimatized well to farm conditions. This sable exhibited hyperchromatism. The head and chest were light yellow in color, ash gray guard hair uniformly covered the entire body and the underfur was white with bright yellow tips. The pads of the paws were a light yellow.

A L Ponomarev pointed out in an article (1938) that animals which showed a predominant development of dark pigments in the hair were called 'chromists'. The yellow pigment develops freely in such sables and hence they acquire yellow coloration.

The question has arisen from time to time as to the possibility of farm breeding colored sables as a new type of fur-breeding animals (Monakhov and Cheglakov, 1973 and Afanas'ev, 1975). However, to do this, the breeders needed mutants, which could be found only in nature.

In 1977, the Institute started experiments on crossing colored animals with females of standard colors. It is necessary to intensify this work in order to find and supply sables with different aberrant colors.

MORPHOLOGICAL CHARACTERISTICS OF THE
FETAL AND MATERNAL TISSUE IN THE
PLACENTA OF AMERICAN MINKS
(*MUSTELA VISON* BR.)

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A study was carried out on the placenta of American minks from the formation of the primary chorionic villi and their association with the endometrium up to the start of the antenatal period of embryogeny (25 to 17 days before whelping). The gestation period was determined by the method of back calculating the age of the embryo (Kolpovskii, 1971). Twelve fetal chambers of seven gestating minks were studied.

A. Enders (1957) and N. A. Bychkova (1971) isolated three segments in the placenta of minks: infantile or labyrinth zone, maternal, and transitional or contact zone.

The study established that the formation of placental structures started with the fusion of primary trophoblastic villi into the endometrium. Having penetrated the endometrium, the trophoblastic villi fuse into the blood vessels. The maternal blood vessels are covered with an endothelium which lies on the positive basal membrane adjoining a layer of amorphous matter. As a result of growth, the maternal blood vessel becomes locked into the trophoblastic lining, which consists of symplasts and surface cytotrophoblasts. In this manner, the cytotrophoblastic zone of the labyrinth (CTL) is formed.

In the contact zone there are three types of cytotrophoblasts (peripheral cytotrophoblasts CTP): a—cells with vacuolized cytoplasm, b—cells with distinct phagocytic activity, and c—cells with invasive growth capacity.

A statistically significant increase in the size of the CTP nuclei compared with those of the CTL has been established by morphological measurements. It appears that vacuole formation in the CTP is associated with the hormonal function of the chorion.

The transitory zone is characterized by polymorphism of cellular elements. Along with the typical decidual cells there were large mono- and polynuclear cells which reacted positively with the DNA. Cytoplasm of large cells was active in relation to the RNA. It is wholly possible that these cells arose as a result of endomitotic reduplication.

In the embryonic development of American minks there are definite and successive structural changes in the cytotrophoblasts which determine the zonal formation of the placenta.

MORPHOPHYSIOLOGICAL STATE OF THE NEUROENDOCRINE SYSTEM IN MINKS UNDER WARM CLIMATIC CONDITIONS

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The neurosecretory and endocrine systems, which support homeostasis and regulate metabolism, play an important role among the integrating systems by activating the adaptive response of an organism to the ever changing conditions of the external environment. However, under the influence of various environmental factors, the secretory function of the neuroendocrine system undergoes adaptive changes. For example, in response to high temperatures, there is a definite change in the functional state of the neurosecretory cells of the hypothalamus, pituitaries, adrenal, thyroid and other endocrine glands. During a thorough study of the biology and characteristics of minks reared in the new natural climatic conditions of Uzbekistan, it was necessary to understand the importance of endocrine factors in the morphophysiological adaptations of the organism during the process of acclimatization.

The purpose of the present work was to study the response of the neuroendocrine system during natural warming of the mink organism. The study took place in the warm summer of 1976 on the fur farms of the Uzbek consumer cooperative.

The subjects of investigation were American minks, adults and kits three to four months old, of standard and palomino types. One group consisted of animals introduced that year and the other group consisted of introduced minks of the third or fourth generation. The investigation was carried out in July and August when the atmospheric temperature was 37° to 39°. In a period of 45 days, the temperature daily reached 41 to 42°. This level was maintained for 7 to 8 hr a day. The hypothalamus-hypophyseal neurosecretory system (HHNS), adenohypophysis, thyroid and adrenal glands of endocrine secretion collected from dead and sick minks with clinical symptoms of heat stroke were investigated. In this condition the mink was characterized by disturbances in respiration and blood circulation, adynamia, and salivation. In order to study the morphophysiological state of the neuroendocrine system morphometric, histochemical and electronmicroscopic studies using indicator doses of radioactive isotopes were carried out.

The results of investigations show that in the process of warming of the mink organism, significant changes take place in the morphophysiological

FERTILITY OF A FARM-BRED FEMALE WHITE FOX

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An important problem facing fur farmers is the rearing of new types of fur-bearing animals. Among these the white fox holds great promise.

Work on rearing the white fox by crossing wild white foxes with females of the Norwegian type was carried out on the Vyatka fur farm of the All-Union Scientific Research Institute of Game Management and Fur Farming from 1965 through 1970 (Kuris, 1972). However, this promising work was subsequently abandoned.

By 1971, a small group of white farm-bred foxes reared at the Institute was maintained at the biological station (8 females and 3 males). In the following two years, the population rose to 11 females and 5 males.

Based on an analysis of the estrous period and embryogeny among female white foxes reared in pens from 1974 up to 1976, the white fox was found to have a much later period of reproduction than the silver and blue foxes. The first matings were recorded in the last five days of March and the very last of them in the last five days of April. The mean gestation period was 53 ± 0.45 days from the first mating. The mean yield of cubs per littering female was 5.8 ± 1.2 , it was 5.0 ± 2.6 , 6.9 ± 2.3 and 5.0 ± 1.8 in different years. The average yield of cubs per female in the group was 3.7 ± 1.7 , it was 2.27 ± 2.6 , 4.93 ± 2.3 and 3.75 ± 1.8 in different years.

When handling farm-bred white foxes, it was found that quite a high percentage of females remained sterile. The average percentage of sterile and single females over the three-year period was 35.1. Year-old females invariably remained single and sterile.

GROWTH PECULIARITIES OF JUVENILE STANDARD MINKS IN THE SOUTH

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For animals reared in sheds, atmospheric temperatures up to 25° are regarded as optimal (Perel'dik and Titova, 1950). E D Ilina (1975) pointed out that a constant high temperature (above 30°C) caused loss of appetite in young minks. The presence of left over feed in warm weather did not mean they were eating adequately (Pisarenko, 1974). These investigators pointed out that loss of appetite and reduced feed intake lead to a growth lag in juveniles. In an earlier work, the author (O Ya Yazan) showed how high temperatures (above 30°C) influenced the feed intake of young minks and how this was reflected on their growth under the climatic conditions of southern Europe.

A comparative study has been made of the growth of young minks and their growth peculiarities in the summer period. Under investigation were young minks of the Odessa fur farm obtained from animals brought from the Vyatka fur farm in Kirov. On the Vyatka fur farm, the control group of juveniles consisted of animals of male lineage brought to the south. In all, 536 young animals of the first, second and third generations were included in the three years of study.

The test animals on both of the fur farms were bred in standard sheds. They were given the standard ration used on each farm. The animals were given water to drink eight times a day. The feed intake was calculated on hot summer days.

The results of observation established that on hot days, the animals did lose their appetite. Feed intake calculations showed that, on particularly hot days, the animals consumed only 40% of the feed given, while some refused feed altogether. In view of this, during the intensive growth period of the young in the summer months of 1971 and 1972, the feed level of animals on the Odessa fur farm was actually much lower (on an average by 107.4 kcal) than on the Vyatka fur farm. As a result, from the age of two months the animals in the south recorded a lower average of daily weight increase. Thus, minks of the first generation showed less weight gain per day than juveniles on the Vyatka fur farm: the weight gain of females was 1.8 g and of males 4.6 g. The corresponding values for second and third generation animals were: females 2.6 and 2.4 and males 10.0 and 2.0 g, i.e., the animals in the south lagged behind in their growth. In August, the first and second

state of the neuroendocrine system. These changes are accompanied by an increased functional level of the HHNS and adrenal cortex, and a lower functional level of the adenohypophysis and thyroid. The morphology of these organs shows a sharp enlargement of vascular capillaries, loss of neurosecretory fluid in the neurons of supraoptic and paraventricular nuclei and the absence of it in the posterior lobe of the pituitaries. Along with cells containing neurosecretory fluid, there are a large number of gram-negative cells among the supraoptic nuclei. Fewer glycoprotein granules in the basophils of the adenohypophysis is accompanied by their hypertrophy and vacuole formation with granulation of a significant area of the cytoplasm. There is an increase in the internal diameter of the follicle in the thyroid, a decrease in the height of the thyroid epithelium and the presence of a dense colloid secretion. In the adrenal cortex there is a reduction in the content of ascorbic acid and lipids. A comparative analysis of the response of the neuroendocrine system to warming of the body during a hot summer showed that changes are more distinct in kits than in adult minks. Differences were also observed in the response of the neuroendocrine system among acclimatized minks.

GENETICS OF THE COLORATION OF SPECKLED MINKS

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In 1973, for the first time, 13 female minks with a speckled hair coat were imported into the Soviet Union from the USA.

The speckled coloration of the hair coat of these minks was caused by clearly defined white spots over different parts of the body of standard minks. Their eyes were dark blue.

The work was carried out on the Roshchinsk fur farm in Leningrad district and on the Rodnika experimental commercial farm of the Institute, from 1973 to 1976. To study the genetics of the hair coat coloration of speckled minks, tests were conducted on standard, pastel, silver-blue, sapphire and white (Headland) minks. The phenotype of kits was evaluated at the age of 25-30 days.

The mating of speckled minks with standard and color recessive minks showed that the genes responsible for the coloration of hair coat of speckled minks were recessive, since all of the kits in their litters were of standard color.

The results of mating white animals, obtained through the inbreeding of speckled minks with Headland minks, showed that these kits possessed the genotype (hh). Reciprocal matings of speckled minks with white ones (Headland) and the inbreeding of speckled minks led to the conclusion that speckled minks carried a new gene of speckled color (h^s), allelic to the Headland gene. Based on these data, speckled minks can be regarded as heterozygotic with respect to the gene Headland (h) and the gene of speckled color (h^s) allelic to it, i.e., they represent a compound form with the genotype $h^s h$. In 1976, there were a total of 215 female and 119 male speckled minks in the main herds on both farms.

generation animals recorded a statistically significant lower weight females by 243 g and 120 g and males by 685 g and 151 g ($P > 0.999$). In third generation females, the weight in August was the same on both fur farms, the males in the south, however, weighed 189 g less ($P > 0.999$).

When the hot weather ended, the young in the south began to grow more rapidly and their weight increases were greater than those of the young on the Vyatka fur farm. However, the growth lag of animals of the first and second generations was not completely compensated for, and by the time of killing, they weighed less than the controls: 687 g and 300 g less in the case of males and 222 g and 250 g less in the case of females ($P > 0.999$). The young of the third generation showed no significant weight difference at the time of killing.

Thus, in the south during the summer, at temperatures above 32°C , young minks lose their appetite, as a result of which their food intake decreases. If the high temperatures remain constant for more than a month, the growth of the young is impeded and is not compensated for even by excellent intake in the autumn, the young do not revert to normal size. A whole complex of measures should be taken to improve the feed intake by the young. The feed regime should be changed: minks in the south should be fed no later than 6 or 7 o'clock in the morning and no earlier than 6 or 7 o'clock in the evening, the temperature of the feed mixture should be lowered to 10° to 12°C and abundant cold water should be provided for drinking.

Physiology and Feeding of Fur-bearing Animals

A CASE OF UNDERFED YOUNG MINKS

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As a result of unfavorable conditions, minks on the Odessa fur farm did not feed for several days in November 1975.

In an experimental group of animals, which after weaning were weighed every month, a study was carried out to determine how underfeeding affected the size and weight of the animals and the functions of some organs. With this in view, 25 females and 25 males were killed from a group of animals whose weights were known before underfeeding. The killed animals were weighed and measured. The lungs, liver, heart, kidneys and spleen were prepared and weighed. The steamed and dried pelts were also weighed and measured. All of the data were biometrically processed and the indices of internal organs calculated.

Analysis showed that the live weight of males decreased by an average of 496 g and that of females by 277 g ($P > 0.999$), in comparison with the preceding month. The coefficient of weight variation in males doubled, which demonstrated the different responses of individual animals to underfeeding. This was confirmed by diverse coefficients of variation of linear measurements such as chest circumference behind the shoulders, which decreased by 4.7 cm in males and by 5.98 cm in females ($P > 0.999$). The weight of liver, heart and lungs also decreased.

The area of pelts in relation to live weight showed that in males it shrank by 72 sq.cm and in females by 52 sq.cm ($P > 0.99$). Thus, the underfeeding of minks had an adverse effect on the live weight of the animals; moreover, the pelt area, as well as the weights of internal organs, also decreased. Thus underfeeding of minks in the period before killing had an adverse effect on pelt quality.

DWARFISM AS A MANIFESTATION OF FEEDING DISTURBANCES IN FEMALE MINKS AND MINK KITTENS

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In recent years, some state fur farms in the Russian Soviet Federative Socialist Republic have reported a disease among young minks which occurs in the period of weaning. This disease was manifested by a lag in growth and development, skeletal deformation and weakened resistance to adverse environmental conditions. The weight of sick kits dropped from one third to one-half that of healthy ones of the same age. The thoracic portion of the vertebral column and the sternum were flexed, extremities were stunted and bent, and there was under wetting. The kits crawled on their belly and the wool around the anal opening was soiled with foul smelling excreta. In most of the animals, the large intestine was filled with feces due to atony. Most of the sick animals died at the age of 1.5-3 months with clinical and anatomical symptoms of rickets. In some of the surviving kits the symptoms of rickets disappeared, but most of the sick animals remained underdeveloped with a deformed vertebral column.

Sixty minks aged 2-4 months were autopsied and histologically investigated. Pathological and anatomical autopsies showed anemia of the mucous membrane, distorted vertebral column 'beads' on ribs, relative softness of bones and stunted extremities, especially the posterior ones. Atelectasis was noticed in animals with an intensely distorted vertebral column and sternum.

Histological alterations were particularly noticeable in the bone tissue. These were characterized by a disturbance in the ossification process, insufficient mineral deposition and hypoplasia and fibrosis of bone marrow.

A comparative study of the serum and bones of dwarf and normal animals was undertaken in early September. The serum calcium level among sick animals was low ($P > 0.95$) and the magnesium level high ($P > 0.99$). Moreover, the dry matter content was much lower in the bones of dwarfs than in normal animals ($P > 0.99$). The hemoglobin level in their blood was also subnormal.

In order to determine the relationship between mineral matter availability and disturbance, an experiment was conducted to study the effect of feed additives containing assimilable iron as well as calcium and phosphorus in the ration of dwarf minks. The test lasted from September 13 up to

ECONOMICS OF FEEDING MINKS WITH HOMOGENIZED FEED

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Some fur farms have recently been equipped with homogenizers for the continuous preparation of feed mixtures. However, the process of rearing the animals on homogenized feeds has been proceeding rather slowly as this aspect has not been adequately studied.

In 1976, the Gagarin farm carried out investigations to determine the efficiency of feeding homogenized rations to young minks. For this purpose, two groups with 28 analogous males each were formed. The animals were reared in pairs in cages of standard size with one group receiving the usual ration (size of chopped meat, 12 mm) and the other the same mixture which had been passed through a homogenizer. Experimental feeding continued from July 10 up to October 1: the animals were fed manually. Feed remains amounted to 7%.

In the growth period, the young were weighed, the feed edibility and losses calculated (eight test days) and the size and quality of pelts evaluated after slaughtering the animals. These data are discussed below.

The test animals which received the homogenized feed initially lagged behind in weight, the difference on September 1 being statistically significant (1,700 and 1,785 g, $t_d=2.51$), however on October 1 and November 1, and at the time of slaughtering the weight differences were statistically insignificant. For example, at the time of slaughtering, the test animals

Table 1 Results of feed intake calculations (in g per animal over an eight day test period)

Group	Feed given	Unconsumed feed	Loss	Consumed
Experimental	2,800	239	50	2,511
Control	2,800	175	82	2,543
Differences in the indices of the control group compared with those of the experimental group				
a) for the eight-day test period	—	-64	+32	+32
b) per day	—	- 8	+ 4	+ 4

November 11, 1976, and covered 51 standard and 48 pastel dwarf males. The addition of iron to the feed had a positive effect, as reflected by the increase in blood hemoglobin and dry matter content of the bones of sick minks to the normal level.

Further, the death of animals in the groups which were given the iron preparation dropped to 27.0% against 43.9% in those which did not receive it. The number of white-wooled pelts was lower in the groups given the iron preparation.

No significant differences were found in the excreta in the number of white-wooled pelts or in the percentage of dry matter in the bones between animals which had been administered preparations containing calcium and phosphorus and those which had not received them. At the same time, however, the hemoglobin level was very low.

That dwarfism was associated with iron deficiency anemia was also confirmed in an analysis of the feeding of fur-bearing animals on the Bakanassk state fur farm in the Krasnodar region. By excluding pollock, that contains a high amount of trimethylamine oxide, from the ration of gestating and lactating female minks and by replacing it with properly stored fish, dwarfism was totally eliminated among mink kits.

SOME FEATURES OF METABOLISM IN STANDARD MINK

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Between 1973 and 1976 several experiments were carried out on the Vyatka fur farm to determine precisely the feed and energy requirements of large standard minks. Test minks before the estrous period and during gestation received rations with identical proportions of nutrients but with different calorie contents by varying the amount of feed. Before the estrous period, the level of feeding was decreased by 15-30% compared with the standard level. In the first and second halves of the gestation period, the calorie content of the feed ration was varied by 10-15%.

In scientific and field experiments, feed balances were calculated in the latter half of February and the latter half of April. In order to study the metabolic characteristics and the digestibility of nutrients, four or five females were selected from each group with weights characteristic of that group. A comparison of the results of feed balance calculations for juveniles and large adult minks before the estrous cycle and during gestation point to noticeable metabolic variations.

Before heat, minks of different ages were characterized by a definite nitrogen equilibrium. Nitrogen utilization at this time by minks of different groups did not exceed 4.5% of intake and was independent of the feed protein level. In all cases, an excess of feed protein led to increased nitrogen liberation from the organism mainly in the urine. It should be pointed out that rations with 16 or 17 g of digestible protein ensured nitrogen equilibrium before heat.

During the gestation period, the nitrogen balance in minks was positive. Its utilization increased absolutely as well as relatively. Differences in nitrogen utilization were not noticed in juvenile and adult minks, or when the protein content in the feed ration was varied. In minks of different groups, the mean daily deposition of nitrogen was equal to 0.27 g, which was 6.5% of intake, the range being 2.0-16.4%. A positive nitrogen balance was ensured by supplying 20.4-23.5 g of digestible protein with the feed. The excess nitrogen intake was excreted in the urine.

Minks put on rations containing 2.0 g or more of calcium assimilated 53-68% of it. A reduction in the calcium content of the feed led to a reduction in its utilization. Calcium was excreted from the organism mainly through the intestine and only an insignificant portion (2-3%) through the urine.

Table 2 Size and quality of the pelts of minks given ordinary and homogenized rations

Index	Unit of measurement	Ordinary feed	Homogenized feed
Pelts	Number	27	28
Passed for size	%	123.07	123.75
Loss due to defects	%	23.7	20.9
Average passed for quality	%	94.3	97.7
Average price realized	rub	50.54	52.37

weighed an average of 1,945 and the controls 2,010 g. The reason for this will be established in future studies. In terms of per head per day, the animals receiving normal feed consumed 4 g more but also lost 4 g more (Table 1).

Thus, the intake of homogenized feed compared with that of the usual ration was 8 g less (2.6%) per day per animal. The size and quality of the pelts of test animals were better than those of the controls (Table 2). It is possible that these were due to the excellent assimilability of the homogenized ration.

Thus, the use of homogenized feed is advantageous in rearing young minks intended for slaughtering. With a slight expense in procuring and operating a homogenizer, the profitability of mink breeding can be increased by reducing costs and improving the product quality. Feed homogenization saves 400–500 kg of feed a day in the summer and autumn periods.

REPRODUCTIVE CAPACITY OF MINKS REARED ON RATIONS WITH DIFFERENT FAT AND CARBOHYDRATE CONTENTS

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Investigations carried out by Soviet and foreign scientists have shown that it is possible to raise the feed carbohydrate levels of young minks to 30-35%. The majority of fur farms, however, use rations with high fat and low carbohydrate levels.

In order to determine the optimum carbohydrate level in the feed ration of juvenile standard minks intended for pelt recovery, field tests were carried out in 1975 at the Vyatka fur farm of the VNIOZ. Three analogous groups, each containing 40 females and 40 males were used.

During the period of growth, from July to November, the rations contained the following amounts of protein, fat and carbohydrates (as a percentage of their respective calorie contents): group I—36, 35 and 29, group II—34, 42 and 24, and group III—34, 48 and 18.

The males were killed in November, while the females were transferred to the main herd in order to study how feed differences in the growth period influenced the reproductive characteristics of the juveniles. From that time on, minks of all groups received feed in accordance with the farm norms.

After the whelping of females and the weaning of kits, indices characterizing the reproductive capacity of minks were calculated (Table 1).

Table 1. Reproductive capacity of test minks

Index	Group I	Group II	Group III
Females in the main herd	28	31	21
Whelped, %	92.86	74.19	76.19
Kits born, total	138	147	96
Stillbirths (%)	9.48	8.84	7.29
Kits dead (%)	12.10	14.18	16.85
Fertility of females	5.26 ± 0.39	6.39 ± 0.51	6.00 ± 0.63
Kits weaned per female	3.89 ± 0.37	3.70 ± 0.39	3.52 ± 0.45

No perceptible differences were found between the groups with respect to all of the indices characterizing the reproductive capacity of minks. Among the minks of I Group, there were two instances of unfavorable births, while

Utilization of phosphorus, like calcium, was dependent on its intake with the feed. When the ration contained about 1 g of phosphorus, 37–51% of it was assimilated. A lower intake of phosphorus reduced its absolute and relative utilization and when the intake was 0.41–0.55 g, the phosphorus balance was adverse. Roughly two-thirds of the phosphorus was excreted by the organism through feces and about one-third through the urine.

Experiments did not establish a difference in the digestibility of feed nutrients of varying calorie contents before heat and in the gestation period. Females in the first year before heat and in the gestation period recorded somewhat better digestibility of nutrients than did adults.

In the gestating young and adult females, the digestibility coefficients of organic matter, protein and carbohydrates were noticeably greater than before the estrous cycle. This is particularly true of carbohydrates. While the digestibility coefficient of organic matter rose by 2.3–6.9%, that of carbohydrates went up by 21–25%.

In the latter half of gestation, the protein and carbohydrate requirements of minks can be expected to increase. This can be explained by the fact that the fetal period in minks lasts for about ten days.

there were no sterile females. In the second and third groups, however, 24-26% of the females remained sterile.

Thus it can be stated that, in the growth period, rations containing 30% carbohydrates with moderate levels of protein and fat do not affect the reproductive capacity of female minks.

FEEDING LEVEL OF LARGE MINKS

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In light of the successful selection of fur-bearing animals for their size, the need has arisen to determine accurately the nutrient and energy requirements of large minks. As a rule, large females are characterized by a high degree of fatness which reduces their reproductive capacity.

In the autumn of 1972, on the Vyatka fur farm of the VNIIOZ, a group was formed of females weighing over 1.4 kg. Considering that selection for size (for weight) was extremely effective and the degree of inheritance of this feature was 30-40%, the average live weight of minks from 1973 through 1976 was brought up to 1.7 kg and that of males to 3.5 kg. This population served as the basis for a series of experiments on the reproductive capacities of minks put on different feed levels before heat and in the gestation period.

Laboratory and field tests were carried out using the method of balanced groups. Minks of all groups received rations containing nutrients in the proportion used on the farm, but of variable energy content which was adjusted by varying the amount of feed. Thus altered the overall intake of nutrients.

It has been demonstrated that a 17-22% reduction in the weight of minks before heat leads to an increased productivity of 0.5-1.0 kit per female in the main herd. The rise in the yield of kits was the result of a reduction in the number of sterile females and stillborn kits and also due to reduced mortality of juveniles.

A reduction in live weight and fatness was achieved by restricting the feed level of the minks before heat by 27-30% in comparison with the prevailing norms. This did not affect the physiological state of the females or the growth of the young. Juveniles and large adult minks responded identically to the feed level restrictions.

In tests with large minks, feed level restrictions of 15% before heat, as well as 10-25% in the first and 10% in the second half of gestation, were not reflected on their reproductive capacity. However, restricting the energy level of the ration by 27-30% before heat and by 10% in the second half of gestation led to increased mortality of the young, a greater number of stillborn kits and reduced fertility of the minks. A 15% increase in the feed level of large minks in January-February, as well as during gestation, reduced the productivity of females mainly due to the increased number of still-births.

Thus, the results of these tests suggest that a reduction in the feed level

by 27-30% compared with the prevailing norms 2.0-2.5 months before heat is necessary to properly prepare large minks for heat.

Restricting the feed level of minks before heat should be accompanied by regular weighing of the animals and visual assessment of their well-beings at least once a month.

It is desirable to put the minks back on the normal feed level 5-7 days before heat, since this would promote their increased reproductive capacity.

The *calorie level of the rations of large minks during the periods of heat and gestation (while restricting the feed by 27-30% before heat)* should correspond to the prevailing norms.

EFFECT OF ADDING ZINC SULFATE TO THE FEED ON THE REPRODUCTIVE CAPACITY OF MINKS

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The medicinal properties of zinc have been known to medical practitioners since the time of Galen. Zinc has a significant role in the metabolic regulation of basic nutrients. Zinc deficiency reduces the feed intake, disturbs carbohydrate and fat metabolism and suppresses protein synthesis and reproductive processes. Its excess produces poisoning (Prusova, 1966 and A. Khennig, 1970).

This work studied the effect of zinc sulfate on feed intake in the period preceding the estrous cycle and gestation, as well as its effect on the reproductive capacity of young standard minks.

In experiments carried out on the Vyatka fur farm, 210 females with an average live weight of 1.1 kg were used.

The animals of the first group served as controls, while those of the second, third and fourth groups received zinc sulfate additives at the rates of 1.8, 3.6 and 5.4 mg per head per day from January 8 to April 24. All of the test animals received feed as per the normal level on the fur farm. A feed of 9.1 g protein, 4.7 g fat and 3.5 g carbohydrates gave 100 kcal of metabolic energy. The feed intake of the groups was good and all the animals lost 60-90 g of live weight by the time of heat.

Within a month after starting the experiments, morphological and biochemical investigations of the blood were carried out in five females of each group to control the physiological state of the animals.

In minks of the experimental groups, in comparison with the controls, there was increased hemopoiesis and improved lipid metabolism. Zinc sulfate at the rate of 1.8 mg per head resulted in favorable changes in the red and white blood corpuscles while the addition of 3.6 and 5.4 mg of zinc salt caused leukocytosis and partial hemolysis of erythrocytes.

The productivity of minks was highest in the second group of females. The results of heat and whelping are given in Table 1.

The addition of zinc salt to the second and third groups of minks enabled the yield of kits per female to be raised in the main herd. Although the differences in comparison with the control group were statistically insignificant ($t < 2$), a significantly larger number of kits was born to the second group of minks.

Table 1. Productivity of experimental minks

Index	Group			
	I	II	III	IV
No. of females at the beginning of the experiment	30	52	50	52
No. of sterile females (%)	22.0	13.5	16.0	17.3
Female whelping (%)	78.0	86.5	84.0	82.7
Kits born				
Live births	213	281	241	247
Stillbirths	26	20	19	13
Female productivity	6.1 ± 0.32	6.7 ± 0.35	6.2 ± 0.41	6.05 ± 0.27
Kits weaned per				
female giving birth	4.9 ± 0.14	5.7 ± 0.32	5.1 ± 0.33	5.05 ± 0.30
female in the main herd	3.9 ± 0.44	4.9 ± 0.38	4.3 ± 0.38	4.1 ± 0.35

Much higher zinc doses (3.6 and 5.4 mg per head) did not have any adverse effect on the fertility of females, but had an adverse effect on some blood characteristics

EFFECT OF TRACE ELEMENTS ON THE REPRODUCTIVE CAPACITY OF YOUNG STANDARD MINKS

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The positive influence of trace elements on the growth, development and productivity of minks in several regions of the Soviet Union has been reported by Ya M Berzin' (1958), O P Belugina et al (1962), A F Orlov (1965), E P Bobrov (1966 and 1967), G B Mamaeva (1966 and 1967), Yu I Kostromichev (1967), N R Vinogradov (1968), V P Bukhmenov and V N Gubenko (1970) and L M Smelovskiy (1975)

Laboratory and field tests were carried out on one division of the Vyatka fur farm from February 1 through April 25, 1975, to study the effect of the addition of the most important trace elements on the reproductive capacity of young standard minks. The females were selected from the animals intended for slaughtering. They weighed an average of 1.12 kg and were divided into three analogous groups, they were put on the normal rations used on the farm. The animals of the first group served as controls. The second group received 0.3 mg of manganese sulfate, 0.4 mg of cobalt sulfate, 0.98 mg of copper sulfate and 30 mg of iron glycerophosphate per day per head.

In addition to the above, the females of the third group received 0.59 mg of zinc sulfate. The feed edibility in all groups was good, the live weight of the animals before heat dropped by an average of 50-60 g. The addition of trace elements had a positive effect on the reproductive capacity of experimental minks, as can be seen from the data given in Table 1.

Table 1 Reproductive capacity of experimental minks

Index	Group		
	I	II	III
1	2	3	4
No. of females at the beginning of the experiment	61	60	62
No. of sterile females (%)	21.31	11.67	17.74
Females whelping (%)	78.69	88.33	82.26

(Cont'd)

Table 1 (Contd.)

1	2	3	4
Kits born:			
Live births, numbers	252	301	309
Stillbirths, numbers	24	18	21
" (%)	8.70	5.64	6.36
Female productivity	5.75 ± 0.34	6.02 ± 0.30	6.47 ± 0.33
Kits weaned per:			
female giving birth	4.6 ± 0.34	4.96 ± 0.32	5.39 ± 0.31
female in the main herd	3.62 ± 0.35	4.36 ± 0.35	4.43 ± 0.36

The most effective method was the simultaneous addition of all five constituent trace elements, as in the feed of the third group of minks. The yield of kits from minks of the second and third groups was higher, though the difference in comparison with the controls, was statistically insignificant ($t < 2$)

DIGESTIBILITY AND UTILIZATION OF NUTRIENTS WHEN ZINC IS ADDED TO THE RATION OF MINKS

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Fur bearing animals effectively utilize feed nutrients when adequate amounts of trace elements are present.

Kirov and its adjoining areas supply the main feed (except marine fish) for the fur bearing animals on the Vyatka fur farm. These areas are located in a geochemical zone which is deficient in the most important microelements (Onagov, 1962). According to the data of the regional agrochemical laboratory, zinc deficiency amounted to 25-30%. Laboratory and field experiments were carried out on a division of the Vyatka fur farm to study the physiological effect of adding zinc sulfate to the organism of young standard minks and to establish their zinc requirement in the preparatory period of the estrous cycle and gestation. In these studies 210 females, with an average weight of 11 kg, were divided into four groups. The animals of the first group served as controls and they received the basic ration of the farm. The minks of the second, third and fourth groups received zinc sulfate daily at 1.8, 3.6 and 5.4 mg per animal from January 8 to April 24. A feed of 91 g protein, 4.7 g fat and 3.3 g carbohydrates gave an average of 100 kcal of metabolic energy.

In light of these laboratory and field experiments, feed balances were analyzed starting in mid-February for five minks of each group to determine the digestibility and utilization of feed nutrients. These showed that the addition of zinc did not reduce the digestibility of feed nutrients (Table 1).

Nitrogen utilization improved under the influence of zinc (Table 2).

Table 1 Digestibility of feed nutrients by minks

Group	Digestibility, %				
	absolute dry matter	organic matter	protein	fat	carbo- hydrates
I	76.39	80.3	80.8	94.1	64.1
II	77.14	81.2	82.3	95.1	62.3
III	78.06	82.2	82.4	95.3	66.0
IV	77.70	81.4	82.7	94.6	63.1

Table 2. Nitrogen utilization by minks (per day per animal)

Group	Intake, g	Excreted, g		Digested, g	Deposited		
		urine	feces		g	% of intake	% of feed digested
I	2.96	2.31	0.59	2.37	0.06	2.02	2.53
II	2.99	2.26	0.53	2.46	0.20	6.69	8.13
III	2.98	2.25	0.52	2.46	0.21	7.05	8.54
IV	2.96	2.29	0.51	2.45	0.16	5.41	6.53

The addition of zinc to the feed did not adversely affect calcium and phosphorus metabolism. Calcium utilization in all of the animals varied from 60.0 to 68.0% and phosphorus utilization from 40.0 to 45.0%.

EFFECT OF FEEDING ON THE SIZE AND QUALITY OF THE HAIR COAT OF EARLY AND LATE JUVENILE BLUE FOXES

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In 1974, on the fox farm of the Vnitsk fur farm, the author made four groups of 25 males and 25 females the control consisted of juveniles born on April 22, while the three experimental groups consisted of the young born late, on May 22. The control and the test groups were formed on the principle of analogues. While the control group consisted of brothers and sisters, the experimental groups consisted of brothers and single-litter sisters.

All of the animals were given the same ration as used on the farm. The metabolic energy content of the daily ration for the early juveniles was assumed to be 100%. The experimental groups (late juveniles), in comparison with the controls received in terms of metabolic energy: group I 100%, group II 115%, and group III 120%. The feed was given strictly by weight and the feed remnants were gathered and weighed. This feeding regime lasted from the time of weaning (June 13 for the controls and July 13 for the experimental animals) through November 1. From November 1 to the time of slaughtering, all of the animals received 600 calories per animal per day.

The control and experimental groups of animals were kept in a separate division located on the northern side of the shed and looked after by a single female worker. The animals were held in pairs of the same sex.

The results of the tests showed that

i) the females took in as much feed as the males and in some cases even more,

ii) there are maximum weight limits of feed which a young fox can consume in a day, these limits differ for the early and late born juveniles, as can be seen from Table 1,

iii) the mean weight of the animals of groups I and II was significantly less than that of controls. The body length of the animals of group I was not only significantly less than that of the controls, but also less than that of groups II and III. There was no significant difference in body length between the control and the late juveniles of groups II and III. The chest circumference of late juveniles of all groups was significantly less than that of the early ones. The females of group III constituted a lone exception,

iv) complete maturity of the hair coat took place seven days later in

Table 1 Maximum amounts of daily feed consumed by the juveniles

Age months	Amount of feed g	
	Early juveniles	Late juveniles
1-2	370-420	450-560
2-3	450-550	600-700
3-4	550-650	800-900
4-5	700-750	950-980
5-6	750	—

Table 2 Mean area of pelts, decimeters

Group	Average for the group	Including for	
		males	females
Control	20.60	23.39	17.81
I	18.18	19.71	16.64
II	19.27	20.44	18.11
III	20.59	21.91	18.45

group I, five days later in group II and two days later in group III, compared with the control,

v) as the level of feeding increased, pelt size differences evened out, as can be seen from Table 2,

vi) the best pelts came from the control group, while those from group III were close to the control in size. The percentage of defective pelts was lower in the control group than in the experimental groups. The poorest quality of pelts was in group I: these were characterized by poor furriness and in many cases a poorly developed voile. The main defect in all of these groups without exception, was the grating of the hair coat on the skull. Damage to hair on the rump was practically absent. Evidently the poor furriness and development of voile and other defects were associated with the level of feeding and the time of slaughtering.

vii) the pelt quality and thus the realization price per pelt of early juveniles were superior to those of late juveniles. As the level of feeding increased, differences in the average realization prices evened out. Feed economy cannot compensate for loss of quality.

EFFECT OF BIOLOGICALLY ACTIVE PREPARATIONS ON HEMOPOIESIS IN MINKS

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Chlorophyll carotene mixtures, provitamin concentrates, and 'aspen fat' are important products obtained during the chemical processing of green wood of coniferous plants. Among the large number of biologically active substances contained in them, the green pigment chlorophyll is the most important. It is known from the data available in literature, that chlorophyll increases the concentration of blood forming elements and the hemoglobin content in man and animals (Zakharova, 1957, Borisenko and Safonova, 1965, Berlinson et al. 1968 and others).

In view of the fact that anemia due to alimentary canal disturbances is widespread on fur farms, the author studied the effect of these preparations on the number of red blood corpuscles in minks.

Experiments were carried out from 1973 to 1976, on the Kondopozhsk and Kuitezhsk fur farms, using weaned kits of silver blue, pastel, white and standard minks.

Experiments using provitamin concentrates established that their administration through feed at 0.1 g per kg live weight of the animals for four months promoted intense erythropoiesis in the experimental animals (9.47 million per cu mm in 1973 and 9.95 in 1974) compared with the controls (8.71 and 9.26 million per cu mm, correspondingly). However, this was true only in the males.

In the blood of silver blue minks reared on rations containing a chlorophyll carotene mixture at 0.1 g per kg live weight, the hemoglobin content of erythrocytes and the hemoglobin concentration of serum were higher (19.12 mg and 368 mg%) than in the controls (18.48 and 1293 respectively). This was in spite of the fact that the number of erythrocytes in them was less (8.85 and 9.37 million per cu mm).

In standard minks receiving this preparation, the number of erythrocytes in the blood was slightly higher only in males (10.07 against 9.74 million per cu mm in the controls).

The results of laboratory experiments on white and standard minks put on rations containing this mixture for two months showed a significant rise in the blood hemoglobin level of white minks (18.8 in the test animals and 17.7 g%, in the controls) and a similar tendency in standard minks (17.9 and 17.2 g%, respectively).

In experiments using aspen fat (0.1 g per kg live weight), the blood of the experimental animals contained a significantly higher amount of hemoglobin (18.11 against 17.27 g% in the controls).

It may be concluded from the above results that chlorophyll preparations (provitamin concentrate, chlorophyll-carotene mixture and aspen fat) promote hemopoiesis among minks and this is reflected in an increased number of erythrocytes and a higher hemoglobin concentration in the blood, particularly among males.

CARBOHYDRATE LEVEL IN THE FEED OF MINKS BEFORE HEAT

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According to the data of several investigators, the proportion of digestible nutrients in the feed of minks can vary widely from December to May protein 41 to 60%, fat 25 to 39%, and carbohydrates 12 to 35% of the caloric content of the feed. In mink breeding practice, there has been a tendency toward moderate feeding of fur-bearing animals during the winter and spring period and a reduction in the protein level by increasing its nutritional value and proper balancing of the ration.

Laboratory and field experiments were carried out on the Vyatka fur farm of VNIIOZ in 1976, to determine accurately the optimal amount of carbohydrates in the ration of minks before the onset of the estrous cycle. For this purpose, three groups of 49 females each, with an average live weight of 1.6 kg, were formed from among young standard minks.

From January 6 to February 22, the caloric content of mink rations was reduced to 70% of the standard and maintained at a level of 170 kcal. From February 23 to the time of whelping, the caloric content corresponded to the standard level. The ration of the first group of minks contained 10% carbohydrates, of the second group 20% and of the third group 30% of the total caloric content, the protein contents were, respectively, 64, 54 and 45%. The fat level ranged from 25 to 27%. From March 1, all the test minks were put on the normal farm ration (50% proteins, 30% fat and 20% carbohydrates).

With the feed limited to 30% of the normal level, by February 23, the weight of minks had dropped by 15-19%, but there was no difference between the groups. Such a weight reduction did not impair the physiological state of these fur-bearing animals. No differences were noticed in the histological and biochemical blood indices of different groups of minks before heat. All the indices lay within the norms, though the hemoglobin content dropped from 20.9-21.4 to 16.4-18.0 g % ($P > 0.90$).

From January 6 to February 29, the caloric content of feed remained constant, but the feeding quantity differed slightly. Minks of the first group in this period consumed 130.4 kg of feed with a natural moisture content, while minks of the second and third groups consumed 438.8 and 471.8 kg.

Different proportions of nutrients in the feed of standard minks before heat did not lead to significant changes in female productivity. On the

average, the first group yielded 3.57 kits, the second group 4.55, and the third group 4.27 kits per female in the main herd. The second and third groups included *one-half to two-thirds sterile females and stillbirths*, but these differences were statistically significant only between the first and second groups ($P > 0.95$).

An increase in carbohydrates and a decrease in protein levels in January-February did not adversely affect the growth of the resultant kits. At birth, the females of the second and third groups were heavier ($P > 0.95$) while the males of different groups weighed almost the same. At the time of weaning, there were no significant differences in the weight of different groups of females. The weight of the second group of males was 21 g ($P > 0.95$) less than that of the first group, the males of the third group weighed, on the average, 489.5 g, i.e., 75 g more than that of the first group ($P > 0.999$).

Thus, it may be stated that an increased carbohydrate content and reduced protein content in the feed of standard minks before heat did not lower the indices of female productivity.

PROPORTION OF NUTRIENTS IN THE FEED OF GESTATING FEMALES

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The results of experiments carried out by researchers at the laboratory from 1973 through 1976, showed that the calorie content of the ration given to gestating minks should correspond to the prevailing norms, while the feed level should be restricted by 30% or more before heat. It was also pointed out that in the period of gestation, not only the protein requirement of minks, but also the carbohydrate requirement, increases perceptibly. An attempt has been made to study the physiological state and productivity of minks and the growth of juveniles put on rations of different compositions during the gestation period.

For this purpose, in 1976, laboratory and field experiments were carried out on the Vyatka fur farm of the VNIIOZ, using three groups of adult standard minks with an average live weight of 1.23 kg. Each group comprised 48 or 49 females selected on the principle of analogues.

In the preparatory period starting on December 16, 1975, all of the animals received feed according to the norms. From January 4 to February 23, 1976, the calorie content of the feed of experimental minks was reduced by 30% as compared to the prevailing standard and maintained at a level of 160 kcal. From February 24 to the time of whelping, the minks were fed the normal rations.

From the beginning of the test to the end of the estrous cycle, the animals received the normal feed used on the fur farm. During the gestation period, from March 26 to the time of whelping, the minks received rations containing different proportions of nutrients. On the average, for the gestation period as a whole, the feed contained the following amounts of protein, fat and carbohydrates (as a percentage of calorie content): first group 50, 35 and 15, second group 45, 30 and 25, and third group 40, 20 and 30.

On January 1, 1976, the average weight of different groups of minks ranged from 1,227 to 1,254 g. By February 20, with the feed restricted to 30% of the normal feeding level, the weight of minks of the second and third groups dropped to 1,098 to 1,112 g ($P > 0.999$) while it remained unchanged in the first group.

Histological and biochemical indices of blood before the estrous cycle were within the normal limits. Only in the second group of minks was the content of total serum protein, at 6.43 g %, less than in minks of first group.

($P > 0.95$) No differences between the groups were detected in the number of erythrocytes, leukocytes and concentrations of hemoglobin and sugar

Differences in the proportion of nutrients in the ration of gestating minks had a discernible influence on their productivity. In the first group 5.02 kits were weaned, in the second 5.27, and in the third 3.90 kits per female. The much higher yield of kits from the second group of minks was due to a reduction in stillbirths and dead kits.

With the varying nutrient content of the feed given to the gestating females, the weight of the young at birth and at the time of weaning also differed, females of the second group were bigger. Among males, there was a higher weight at birth in the second group and at the time of weaning in the first group.

FAT AND CARBOHYDRATE LEVELS IN THE FEED OF YOUNG MINKS

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At present, while rearing young minks, high calorie rations with large amounts of fat and moderate amounts of protein are being widely used. It has been felt that increasing the calorific value of rations for the young by the addition of fat, the utilization of protein would improve. This would stimulate the growth of minks, improve the quality of pelts and reduce expenditure.

Laboratory and field experiments were carried out on the Vyatka farm of the VNIIOZ in 1975, to determine the effect of rations containing different proportions of fat and carbohydrates on the growth and pelt quality of young large sized standard minks. Three groups of analogously weaned young minks, each consisting of 40 females and 40 males, were formed, they were kept in pairs of different sexes in a typical shed. In the preparatory period from June 27 to July 10, the kits were fed the normal rations used on the fur farm. From July 11 to the time of slaughtering, the animals were given the test rations. For the experimental period as a whole, the rations contained the following amounts of protein, fat, and carbohydrates (as a percentage of calorie content), first group, 35.95, 35.07 and 28.98, second group, 33.61, 42.29 and 24.10 and third group, 33.66, 48.49 and 17.85. The males were slaughtered in November while the females remained in the main herd in order to evaluate their reproductive capacity.

During the experiment, the first group of minks showed excellent feed intake, their average daily intake was 24.6 kg of feed with natural moisture, against 21.4 kg and 18.4 kg by the second and third groups. Under these feeding conditions, by November 17, the females in all groups had similar live weights (1.38-1.41 kg). At the end of experiment, males of the first group weighed 2.50 kg, of the second group 2.41 kg and of the third group 2.34 kg. The weight of males in the first group was significantly greater than that of those in the third group.

Histological and biochemical investigations of the blood were carried out at the beginning of the experiment and at the end of it. These could not establish any difference between males and females of different groups in the number of erythrocytes, in hemoglobin, total serum protein and total lipids concentrations or in the activities of aspartate and alanine aminotransferases. However, in the blood of females of the third group, the content of

leukocytes was higher, while the sugar content was lower in the blood of the males of this group.

After preliminary treatment of the pelts, their length, width, area, weight and thickness of the skin tissue were determined. With regard to most of these indices (length, area, weight and thickness of the skin), the pelts of the first group of males were superior to those of the third group. Pelts of the second group of animals occupied an intermediary position.

The test results showed that young standard minks intended for slaughtering can be successfully reared on rations containing about 30% carbohydrates, while the protein and fat levels remain moderate. A high level of carbohydrates, along with a moderate fat content, did not impair the physiological condition of the animals. On the contrary, the males on such a ration recorded excellent feed intake, better growth and larger pelts.

A STUDY OF THE FEED OF RED SQUIRRELS REARED IN CAPTIVITY

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Success in breeding squirrels in captivity is mostly determined by the composition and quality of the feed, the constituents of the feed have already been thoroughly studied. Under natural environmental conditions, within the Soviet Union, the feed of squirrels has been found to contain over 130 varieties of food, excluding the 20 varieties consumed by them when reared in cages (Kiris, 1973).

Based on available information, squirrels feed on a variety of seeds, but they can also feed on fungi, vegetative buds, treebark and other low calorie feeds (Naumov, 1934, Formozov, 1935, Kiris, 1941 and 1944, and others).

In the feed of squirrels, the role of feeds of animal origin is uncertain. Some regard them as accessory feeds (Raspopov and Isakov, 1934) while others regard them as temporary feeds, which are consumed intensely in years when there is a shortage of vegetative seeds (Ognev, 1940). Others regard them as non characteristic feeds with a relatively insignificant role, on the basis of their small proportion in the stomach content (Kiris, 1973). At the same time, instances of squirrels attacking birds (Goltsmaier, 1935) and their hunting for chicks (Patalcev, 1957) have been described. However, the non response of squirrels toward bird nests has also been established, even when the squirrels were in a position to have acted like real predators (Karpukhin, 1972).

A systematic study of the feed of male and female squirrels in nature, during different seasons, helped conclude that these rodents consume feed of animal origin mostly in spring and summer, females did so to a greater extent than males (Karpukhin, 1960). Squirrels most avidly sought animal feed during the gestation period and while feeding their offspring.

However, the use of animal feeds remains uncertain due to the contradictory results of the investigations and the fact that they concerned only squirrels in nature. Hence, along with the ordinary feed, test squirrels at the biological station of the VNIIOZ were given round the year abundant amounts of dried or sun dried meat, whose edibility was controlled for 10 day periods. As the meat was consumed, new bits were given. The results were analyzed for different seasons of the year. It was found that squirrels avidly took to meat, even when cedar nuts or other high calorie feeds were accessible to them. Meat intake was, however, irregular, the greatest intake of it being in spring and summer.

The addition of dried meat to the feed ration of squirrels promoted the survival of offspring by decreasing the tendency of the mother to devour the newborns.

This experiment thus provided an answer to the much debated question of the biology of the feeding of squirrels in nature, and helped to determine accurately the feed composition for their use in captivity. During heat, gestation and rearing of the young by the females, feed of animal origin should be added to the ordinary feed of squirrels.

PRESENT STATUS OF THE FEEDING OF SABLES BRED IN CAPTIVITY

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The feeding of sablems bred in captivity has been studied only slightly. Maintaining the same caloric value in the feed of these animals is one and a half times more costly than that of minks, which belong to the same marten family, since sablems are fed on many valuable feeds such as meat, more costly types of fish, edible fat and grains.

Under the guidance and participation of the author, from 1971 to 1975, investigations were carried out on the feeding of sablems at the NIIPZK and the Pushkinsk fur farm in Moscow district (V F Kladovshchikov, B A Kulichkov, I M Mirokova and N A Tsepikova). In this five year period, 10 laboratory and field tests were carried out on 4,614 sablems of different ages.

The captive sablems matured slowly and began to reproduce normally only after the third or fourth year. The main purpose of our investigation was to determine how the most important factors of feeding affected acceleration of sexual maturity in female sablems. The tests were carried out using rations with different caloric values (differing in palatability and reduced by 15-20%) and digestible proteins (8-10-11 g per 100 kcal of metabolic energy). Moreover, the growth of young sablems and the size and quality of pelts of animals reared on rations with different energy and protein contents were studied.

When fed on rations with different energy and protein levels, adult males mated with 40-50% to 70-85% of the one year females. Only 20-35% of them whelped, the yield of kits per female being 0.2-0.4.

Feeding young sablems on rations with a low level of digestible protein (8.85 g per 100 kcal) did not reduce the size or quality of pelts and was not reflected on the reproductive capacity of the one- to three year old females. At the same time, such rations were 18-20% cheaper than ordinary feeds containing 10-11 g of digestible protein per 100 kcal of metabolic energy.

Thus, these experiments established the optimum caloric level and protein content of rations for young sablems aged two months to three years.

DRY BALANCED FEED MIXTURES FOR SILVER BLACK AND BLUE FOXES

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The use of dry balanced feed mixtures helps reduce by one fourth to one third the labor and expenses on transport, storage, preparation and distribution of feed to the animals. Moreover, feeding with dry mixtures totally excludes the possibility of the animals being affected by botulism, helminthic infections, anemia and certain other diseases.

The following investigations were carried out to formulate wholesome balanced dry feed mixtures for use with blue and silver-black foxes:

- 1 The digestibility of the basic dry mixture has been determined
- 2 The content of metabolic energy has been established
- 3 The effect of feeding dry mixtures on the reproductive function of these fur bearing animals has been studied
- 4 The effect of these feeds on the growth and quality of the fur of weaned young animals and the aftereffects of such feeding on the reproductive capacities have been determined
- 5 Changes in the quality of several feed mixtures after storage have been studied
- 6 Extensive field tests have been carried out with the recommended rations on several state fur farms in the Russian Soviet Federative Socialist Republic

As a result of these investigations, it has been established that digestion of the feed nutrients of wet as well as dry rations was better in silver black foxes than in blue foxes. The amount of intake per single feed did not affect the digestibility of nutrients. Dry mixtures containing oat flour were digested best, while mixtures with wheat flour proved to be the worst of the combinations.

Female minks receiving wet feeds produced a much larger number of kits than those on dry meat fish feeds (the number of kits weaned per main female was 4.2 and 2.6, respectively), these values in the case of silver black foxes were 4.0 and 4.0 and for blue foxes 6.8 and 6.6, i.e., practically the same.

In all of the tests, feeding with dry whole ration mixtures improved the fur quality of both blue and silver black foxes.

The rearing of the young on dry feeds did not adversely affect their subsequent reproductive capacities.

Storage of dry balanced feeds for 3.5 months at room temperature in a layer of 0.5 m did not alter their quality.

Based on tests started in 1973, covering 70 000 blue foxes and 50 000 silver black foxes, it has been established that the cost of the pelts was invariably more and the cost of rearing low on dry animal feeds (fish meal and pupae). Thus, the average cost of pelts of animals reared on wet and dry feeds was correspondingly (in rubles) blue foxes 2 rubles cheaper—79 10 and 81 14 and silver black pelts 3 30 cheaper—84 93 and 88 23.

RESPIRATION OF HEPATIC MITOCHONDRIA IN MINKS AND BLUE FOXES

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Blue foxes and minks are both predators. In spite of the fact that they differ from each other in their living conditions, their basic biological cycles are the same and there is no difference in their seasonal and age-wise metabolic rhythms.

However, in absolute terms, the activity of enzymes in these animals are different (Lebengarts, 1974 and Kozhevnikova et al 1976). Thus minks, which fall into the class of stenobionts of the family of martens, are characterized by a high activity level of the key glycolytic enzyme lactate dehydrogenase (LDG) while its level is low in blue foxes. This feature may point to varying intensities of oxidative metabolism between these animals.

The objective of the present work is a comparative study of the respiratory activity of intact mitochondria among minks and blue foxes in spring.

For this purpose, optimal media of isolation and incubation were selected. The isolation medium was a mixture of saccharose 0.32 M, EDTA 0.01 M, Tris 0.5 M and KCl 0.5 (pH 7.4) and the incubation medium was a mixture of saccharose 0.3 M, Tris 0.05 M, EDTA 0.0005 M, and KH_2PO_4 0.003 M (pH 7.4). Hepatic mitochondria were isolated by the usual differential centrifuge method (Kondrashova, 1974). Endogenous respiration was recorded using an LP-7 polarograph in the presence of 10 μM substrata (succinate, α -ketoglutarate and glutamate) and 200 μM adenosine diphosphate (ADF).

An analysis of the results showed that the rate of endogenous respiration in mitochondria among minks was 2.44 ± 0.24 n AT O/mg protein. In blue foxes, the oxygen requirement was almost double at 4.26 ± 0.60 n AT O/mg protein. Exogenous succinate and α -ketoglutarate were actively drawn into the oxidative processes in blue foxes and minks, but the stimulating effect was more clearly manifest in the latter ($\text{SD}_{\text{succinate}} = 1.4$ and $\text{SD}_{\alpha\text{-ketoglutarate}} = 1.20$).

In the presence of succinate and ADF, the respiration of mitochondria in minks and blue foxes almost doubled, while the addition of glutamate restored the stimulating effect of ADF.

A comparison of the respiratory activity of hepatic mitochondria in minks and blue foxes, with the activities of their LDG activity in minks, pointed to the greater role of glycolysis in cellular energy production. The

latter evidently represented a historic adaptive response to the conditions of hypoxia which are often encountered among these animals as a result of their semiaquatic way of life.

The high respiratory activity of mitochondria and the low LDG values pointed to the predominance of a more complex and effective method of synthesizing energy-rich compounds in these representatives of the canine family.

The intense inhibitive action of ADF and the restoration of its stimulating effect by glutamate among minks as well as blue foxes can be associated with a low energy shift and the transition of the mitochondria of fur-bearing animals in spring into an active metabolic state. This was probably caused by the action of a whole complex of abiotic factors of the external environment on the status of the neuroendocrine system.

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EFFECT OF CHLOROPHYLL DERIVATIVES ON LACTATE DEHYDROGENASE ACTIVITY IN DIFFERENT COLORED MINKS

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Chlorophyll and its derivatives administered internally produce a wide spectrum of biological effects, which are manifested in the stimulation of hemopoiesis, intensification of the functions of different organs, and normalization of blood pressure (Zakharova, 1957, Luk'yanenk, Fragina and Chernomorskiy, 1973 and Rubis and Isaeva, 1974). The positive stimulating effect of these preparations is seen not only in sick animals but also in healthy people and animals. Chlorophyll is close to the hemin structures and this explains its direct participation in the energy processes. The latter lead to intense synthesis of hemoglobin and thus ensure the stability of the organism in regard to hypoxia through intense oxygen supply to the tissues. In this context, a study of the activity of the key glycolytic enzyme lactate dehydrogenase (LDG) would be of particular interest, since it would help in evaluating the degree of aerobic respiration in the tissues and the direction of synthesis of energy-rich compounds.

The experiment covered standard and white minks of the Kuitezhsk state farm in the Karelian Autonomous Soviet Socialist Republic. Chlorophyll-carotene paste at the rate of 0.1 g per animal per day was added to the rations of juvenile minks in July and 0.15 g in August and September. The serum LDG activity level was determined by the ultramicroscopic method (Pokrovskiy, 1964) at the beginning and end of the experiment. The concentrations of hemoglobin and erythrocytes were also determined in the test and control minks at the beginning and end of the experiment.

An analysis of the results showed that LDG activity followed the same pattern of change in standard minks of the test and control groups from July to November. There was an increase in the activity of this enzyme as the animals grew older. This agrees closely with the studies carried out by the authors on the quantitative dynamics of enzyme activity among fur-bearing animals in different periods of ontogenesis (Kozhevnikova et al., 1976).

It should be pointed out, however, that under the influence of chlorophyll derivatives, LDG activity remained at a much lower level than in the control group of animals. This suggests a reduction in glycolytic intensity and the predominance of the aerobic method of synthesis of energy-rich compounds. This is supported by the fact that the fall in the activity of LDG was combined

with an increase in hemoglobin and erythrocyte concentrations and consequently with intensive oxygen supply to the tissues (Rubis and Isaeva, 1974).

A decrease in LDG activity under the influence of chlorophyll derivatives was most prominent in white minks. The very low activity of LDG in white minks in comparison with standard minks in the test group suggests the transition of their metabolism toward a more effective aerobic method of energy production.

The investigations of K.V. Makridina (1967) also established that the high activity of oxidative metabolism was more characteristic of white minks than standard minks.

Thus, the positive influence of chlorophyll and its derivatives on fur-bearing animals in the result of regulation of energy metabolism and stimulation of hemopoiesis, which are more pronounced in white than in standard minks.

ACID-BASE EQUILIBRIUM AND ELECTROLYTE METABOLISM IN MINKS

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The acid-base equilibrium of the blood was investigated in apparently healthy minks on the state fur farms in Kaliningrad district. The overwhelming majority of animals was found to be in a state of metabolic acidosis. The pH of the blood was low, the amount of metabolic acids was high, and the content of bicarbonates low. Simultaneously, the liver was studied under an electron microscope, which showed a change of mitochondria (lightened matrix color, swelling and disturbances in the cristae) suggesting disturbances in the processes of oxidative phosphorylation. The energy deficiency caused in the mitochondria results in the endoplasmatic reticulum densely covering them. The compensating anaerobic oxidation also leads to an accumulation of metabolic acids in the mink. In light of the disturbances in these metabolic processes, a 'fatty' liver state easily arises, often developing into fatty degeneration of the liver.

Electrolyte metabolism in minks reveals interesting characteristics. Attention should be first drawn to the fact that the composition of the serum as a whole is the same as in man. However, in the erythrocytes there are an unusually low concentration of potassium and a very high concentration of sodium and calcium, and there is a high concentration of potassium in the urine. In summer, the sodium content of the serum decreases. This suggests inadequate amounts of fluids in the intercellular space, hematocrit of the blood is increased and blood supply to the organism is impaired. The electromicrographs showed the ultrastructure of cells of the proximal convoluted uriniferous tubules, which exhibited in active resorption of sodium by the kidneys. The high specific gravity of urine can also be explained by these features. Potassium metabolism is closely associated with protein metabolism. More potassium is received per unit weight of minks but, in summer, its concentration in the plasma is reduced. The increased potassium intake displaces sodium from the organism. A specific characteristic of the mineral composition of feeds is that they contain more potassium and less sodium. In autumn, the concentrations of potassium and sodium in the plasma increase, which can be explained by the high metabolic rate in this period. Regular determination of the components of acid base equilibrium and electrolyte metabolism helps in the timely elimination of deficiencies in the supply of feed and water to the animals.

FEEDING FUR-BEARING ANIMALS ON CAPELIN

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Timely supply of feed, particularly readily available local feed which is cheaper than imported feed, plays a decisive role in raising the efficiency of fur farming

A highly promising source of fish feed for the Karelian state fur farms is capelin, which is caught in the northern seas. On the Kondopozhsk state fur farm, work was carried out over several years to determine the effect of feeding capelin on the growth and development, pelt quality and reproductive capacity of minks.

It has been established that the addition of capelin, amounting to 30-50% of the calorie content of meat-fish group, had no adverse effects on the growth of the animals or the quality of their fur.

The young recorded excellent weights: on November 1, the average weights were females 1,106-1,146 g and males 2,145-2,230 g. The pelts obtained from these animals fetched a fairly high price (45 rubles 26 kopeks and 46 rubles 53 kopeks).

From February 5 to May 1, 1974, about 800 standard minks received rations containing 27% in terms of the calorie content capelin (stored for six months). The mean monthly ration consisted of (as a percentage of calorie values) horse meat 12, liver 7.1, head 19.4, byproducts 14.9, milk 1.5, cheese 0.4, barley grit 17.7, protein-vitamin concentrate 2.9, vegetables 0.5, baker's yeast 1.1, and fish fat 2.1. For every 100 kcal of metabolic energy, the minks received 10.37 g digestible protein and 4.51 g digestible fat. The reproductive capacity of the animals was high. Good whelping was recorded among 85% of the females, 5.6% remained sterile, while preregistration wastage was negligible (4.6%). The yield of kits per female in the main herd was 5.0.

In 1975 (from January 2 to March 27), field tests were carried out on standard, silver-blue and sapphire minks of two groups. For the test period as a whole, the average capelin content of the feed was 17% of the caloric value of the animal feed (January 14.6, February 19.5 and March 17.0%). The yield of kits per main female was 5.13 in standard minks, 5.27 in silver-blue minks and 4.13 in sapphire minks. The figures for 1974 were, respectively, 5.03, 5.03 and 3.76. The number of unfavorable whelpings in 1975 decreased in comparison to the preceding year: from 7 to 6.2 in standard minks, 7.5 to 5.1 in silver-blue minks and from 9.7 to 9.0% in sapphire minks.

Limbryonic mortality of kits dropped from 5.1 to 2.9% in standard minks and from 5.0 to 4.1% in silver-blue minks, but rose from 5.3 to 7.3% in sapphire minks.

Thus, the results of experiments have confirmed once again that capelin does not adversely affect minks and can be included in the mink ration during all biological cycles. However, in view of the presence of thiananase enzyme in capelin, when the animals are regular fed capelin, vitamin B₁ supply to the animals must be ensured by including in the ration yeast, thiamine (0.5 mg per head per day) and 'Pushnovit'. Intramuscular injections of a 6% solution of thiamine bromide at 1 ml per mink and 1 ml per blue fox serve as a prophylaxis against avitaminosis for a month. Vitamin B₁ deficiency can also be prevented by boiling the capelin and by alternately feeding the animals with raw and boiled fish (two days in a week with the simultaneous addition of vitamins).

In 1975, on the Kondopozhsk state fur farm, minks and blue foxes were fed 252 tons of capelin, which was 21.9% of their total fish intake. In 1976, it was 117 tons or 21.3%. The substitution of capelin for pollock resulted in a saving of 55,500 rubles in 1975 and 104,000 rubles in 1976.

FEEDS USED ON CONSUMER COOPERATIVE FUR FARMS OF THE KRASNOYARSK REGION AND THE TUVA AUTONOMOUS SOVIET SOCIALIST REPUBLIC

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In the Krasnoyarsk region and the Tuva Autonomous Soviet Socialist Republic, there are six consumer cooperative fur farms which produce fur valued at over three million rubles. The farms in the region are scattered over a large territory from Evenk to the border with Mongolia, hence their feed bases vary significantly.

On the small commercial farms of Oskobsk and Miryuginsk in the Evenk region, over half of the feed consists of the meat of wild animals, domestic deer and freshwater fish. The other half consists of byproducts and pollock, which are supplied by water transport in summer and by air plane in winter. The ratio of the various groups and types of feeds on these farms differs from that normally used in fur farming: 40% of the meat and fish group consists of the meat of wild animals and reindeer and 25% of the fish comes from the local water reservoirs.

Meat byproducts form the main feed base on Bogotol and Yenisey farms (almost half of all feeds are of animal origin), on the Kyzylsk farm these account for around 10%.

On the Bogotol farm (which rears blue foxes and minks), fish feed accounts for about 35% of the meat and fish group, while it accounts for about 10% on the Kyzylsk farm (blue foxes). On the Yenisey farm (silver-black foxes), the proportion of fish feed has decreased sharply in recent years (to 11%). Whale (12%) and meat (5%) account for a significant proportion of the animal feed on this farm.

The feed on the Kezhemsk farm (which raises silver black foxes) differs from that on farms in more southern regions in that it contains large quantities of the meat of wild animals (moose).

In 1973, the Bogotol fur farm used 90.8% of the meat fish feeds laid down in the norms, 57.3% of the grains, 40.7% of the succulents and 30% of the fat.

In 1973, on the Kyzylsk fur farm, the consumption of meat fish feeds corresponded to the norm, i.e., 101%, but there were significant divergences in individual components. For example, five times more muscle meat than the norm was used, while only 66% of the norm of grains were used, and vegetables were almost totally absent.

The highest deficiency of meat-fish feeds was on the Yenisey farm (67.6% of the norm). At the same time, double the norm of animal fat was used, 2.5 times more milk-based feeds (fat-free cheese) and 1.5 times more grains.

It is known that up to 80% of the cost of pelts of farm-bred animals is accounted for by the expense of feeding the animals. The consumer cooperative fur farms in the Krasnoyarsk and Tuva regions have great potential for reducing their feed costs since at present the more expensive meat feeds are being irrationally used and there is a steady increase in the expenditure on meat. The expenditure is also high on grade I byproducts. On all of the farms, with the exception of the Yenisey farm, cheap and readily available grain feeds are used to the extent of only a little over one-half of the recommended norm.

SEASONAL VARIATIONS IN ENZYME ACTIVITY IN DIFFERENT COLORED MINKS

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Increasing attention is being paid to the influence of external environment on the physiological processes in animals. Of particular interest is the ability of farm bred fur bearing animals to maintain the stereotype condition typical of their wild counterparts, which are characterized by a more intense metabolism, significant variations in metabolism and the seasonal occurrence of biological cycles such as reproduction, molting of the hair coat, etc (Afanas'ev and Perel'dik, 1966, Berestov, 1971, Abramov, 1974 and Il'ina 1975). A relationship has been established between the histological and biochemical composition of the blood and factors of nonspecific immunity among minks, on the one hand, and the season of the year on the other hand, (Berestov and Tyutyunnik, 1969, Berestov, 1971, Petrova, 1971 and Malinina 1974). At the same time, data on seasonal changes in the enzyme status of minks have not been found in literature.

The authors determined the activity of lactate dehydrogenases (LDG), amylases, aspartate- and alanine aminotransferases in minks of four genotypes—standard, pastel, silver-blue and sapphire—in winter (February), summer (July) and autumn (October).

Enzyme activity was determined within 24 hr of drawing the blood, using the ultraexpress method of A.A. Pokrovskii (1964).

An analysis of the results showed that in standard minks the activity of LDG fell between February and October, while in the mutant forms a stable and significant reduction in its activity was noticed between February and July and an increase from July to October. Further, the LDG indices in February were an average of 11% more in mutant minks than in standard minks.

The dynamics of the activity of other enzymes of carbohydrate metabolism and amylases were similar in minks of different colors in all seasons: there was a significant reduction in the level of this enzyme from February to July and a fresh rise in October. A much higher amylase activity was noticed in colored minks than in standard minks, which is confirmed by the work of G.G. Petrova (1971) as well as by the presence of a much higher concentration of glucose in these animals during this period.

An analysis of the activity of aspartate aminotransferase (ASAT), the enzyme of amino acid metabolism, showed that its level was the same in

minks of different colors in different seasons of the year. The indices of ASAT activity rose from February to July (on an average by 20%) and later dropped toward October. The high level of this transaminase in summer in all colored minks can be explained by the increase in protein metabolism at that time of year.

Another enzyme, alanine aminotransferase (ALAT), is stable. The dynamics of its activity show an insignificant reduction in its level from February to October, a slight rise is noticed only in silver blue minks during autumn.

It should be pointed out that the indices of protein metabolism are very high in summer, while the level of activity of the enzymes of carbohydrate metabolism is highest in winter.

Thus, changes in the activity level of the enzymes utilized for carbohydrate and protein metabolism in different seasons of the year demonstrate the adaptability of internal self-regulating metabolic processes to changing environmental conditions.

EFFECT OF AGE AND SEASON ON THE INDICES OF NATURAL RESISTANCE IN AMERICAN MINKS

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One of the outstanding problems in biology is the study of the mechanism of resistance of animals to environmental conditions. The serum levels of bactericidal complement, lysozyme, and beta-lysines are used as the main tests for revealing the level of nonspecific resistance. These data represent quantitative indices, the activities of which are dependent on heredity as well as on exogenic factors.

The present study is concerned with the effect of two factors—age of the animal and season of the year—on the indices of nonspecific resistance and the extent of influence of each of them on the overall paratypical factors. For this purpose, an index of the degree of influence η_x^2 was calculated from the ratio Cx/Cy .

The results point out that, among American minks, as they grow and develop (from two to six months of age), the degree of complement activity decreases (from 37 to 23 units), bactericidal activity of lysozyme reaches a maximum at the age of four months (11%), while the lysogenic properties of beta-lysines in two- and three month-old kits go up to 40%, i.e., 1.1 times more than the activity in adult animals.

However, even in the following month, the degree of their activity decreases by almost 2.3 times (to 17%) compared with the initial level, followed by a rise to 45% in six month old kits. While determining the effect of age on each of these three indices, it has been found that it exerted a major influence on the activity of beta-lysines (59%), and slightly less on complement (26%) and lysozyme (12%).

In adult animals, during the course of a year, the dynamics of natural resistance were characterized by a rise in complement activity in spring and summer (up to 24 and 28 units) compared with winter and autumn (18 units), a significant increase in the activity of beta lysines in autumn (up to 46%) compared with the other seasons of the year and a gradual drop in the level of lysozyme activity from 10% in spring to 7% in autumn. The extent of the influence of season on the level of complement was 50%, on lysozyme 16% and on beta lysines 28%.

Thus, these investigations showed that the factors of nonspecific immunity in an organism are subject to the influence of the external environment and the age of the animal, the proportions of which in the overall effect are variable.

LEVEL OF NONSPECIFIC IMMUNITY WHEN BIOLOGICALLY ACTIVE SUBSTANCES OF PLANT ORIGIN ARE ADDED TO THE FEED OF MINKS AND RABBITS

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The presence of valuable biologically active substances, proteins, fats and carbohydrates in plant cells is the basis of their use for medicinal and feeding purposes. The important products obtained from the chemical treatment of green coniferous species and aspen bark are chlorophyll, carotene mixture and aspen fat.

Chlorophyll, carotene mixture was added to the ration of juvenile standard and white minks at 0.1 g per head per day. Aspen fat at 0.01, 0.05, 0.1 and 0.5 g per kg weight was tested on rabbits starting at 60 days of age. The tests were continued for three months. The activities of complement, beta-lysines and lysozyme in the blood serum were determined at the start and end of the experiment.

The activity level of complement among standard minks was 44 units in the controls and 40 units in the test animals at the beginning of the experiment. Toward the end of the experiment, it rose correspondingly to 55 and 44 units, i.e., by 25 and 10% compared with the initial values. Beta-lysine activity rose from 27 to 29% in the controls and from 18 to 23% in the test animals or by 7 and 25%. The level of lysozyme in the control animals, however, did not vary (7.6 and 7.2%) while there was a slight decrease in minks given this mixture (from 7.2 to 6.4%).

Among white minks the pattern was similar, except that the activity of beta-lysines did not vary significantly.

The animals of both colors, controls as well as test animals, were characterized by unidirectional changes in the factors of natural resistance. However, these changes were more gradual in animals which received this preparation in their feed.

Similar dynamics were also noticed among rabbits receiving aspen fat at 0.5 g per kg body weight. The level of complement in the controls rose from 8 to 13 units and in the test animals from 7 to 11 units, i.e., by 63 and 57%. The activity of beta-lysines rose correspondingly from 35 to 72% and from 36 to 64%. Lysozyme level, on the other hand, decreased more significantly in the experimental (from 23 to 8%) than in the control animals (from 18 to 13%). Interestingly, it was this group of rabbits that showed an increase in weight and improved hemopoiesis.

These data demonstrate that biologically active preparations of plant origin, in the suggested doses, had no adverse effect on nonspecific resistance in minks and rabbits, since the indices under study lay within the physiological limits.

SOME FEATURES OF THE EUROPEAN BEAVER'S ADAPTATION TO FOODS UNDER CAPTIVE CONDITIONS

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Experiments on the farm rearing of beavers are attracting increasing attention

In order to study the adaptations of these animals under captive conditions, two year old beavers (a male and a female) with an average weight of 9.5 kg were caught in 1976, near the Ol'shanka River in Cherkassy district. These were reared in metal cages $2.5 \times 2.0 \times 1.0$ m. In winter, the building was not heated, although on days when there was a frost the temperature fell to -6°C . The cages were not specially heated, since intense frosts were not prolonged.

For rapid adaptation to the new feeding regime, the beavers were given abundant feed once daily. The feed mixture consisted of root crops (carrot and beetroot) sometimes fruits, the green mass of different plants, wheat bran and common salt. Plant feed, mainly willow, comprised more than one half of the ration. One kilogram mixture of feed given to the beavers contained 892 kcal of metabolic energy, 22.7 g protein and 10.7 g mineral matter, 1 kg of plant feed gave 1,146 kcal of metabolic energy, 31 g protein and 14 g mineral matter.

The feed requirement per beaver (0.60 kg) was less in summer than in autumn (0.92 kg) and winter (1.07 kg).

Relatively low feed requirements were recorded in July (0.57 kg), September (0.55 kg) and January (0.59 kg). The feed intake was highest (1.86 kg) in November and December.

As a result of selective feeding in the spring immediately after the animals were caught, 90% of the total intake of feed was of plant origin, 74% was of plant origin in summer, 20% in autumn and 5-15% in winter.

A gradual reduction in the proportion of plant feeds in the overall feed intake and an increase in the proportion of easily digestible feeds led to a reduction in metabolic energy per unit weight of feed. This was because, from an energy point of view, the plant feeds were more wholesome than the feed mixtures. But as a result of the increased quantum of intake, specially in autumn, the metabolic energy available to the organism increased. It was 697 to 719 kcal per animal in the autumn-winter period, which was 10% more than in summer. The absolute intake of proteins also increased. At 23.99 g per animal it was 39.8% more in the autumn-winter period than in summer.

During the period of investigation, the average weight of the animals rose by 51% but the weight increase was not uniform. It was noticed only in some months, although the overall tendency of weight increase was maintained. In spring, the increase was 0.75 kg, in autumn 2.02 kg and in winter 2.11 kg. Differences in weight increase can be attributed to uneven feed intake in different seasons.

With the onset of frosts (January and February), the feed requirements of beavers decreased. In January the metabolic energy of their feed intake was 36.64 kcal per unit weight, which was 40% less than in December. The weight increase in this period was 0.9 kg.

With the selective feeding of easily digestible feeds containing small amounts of cellular matter, the activity of the alimentary canal was disturbed. Its normal activity was rapidly restored by putting the beavers back on plant feeds periodically.

Thus, the adaptation of these animals to the new feeding regime is associated with a reduction in plant feed requirement and an increase in easily digestible matter. This leads to a change in the quantitative and qualitative composition of their feed requirement.

TRANSAMINATION REACTION DURING THE EMBRYONIC DEVELOPMENT OF MINKS AND BLUE FOXES

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An important feature of early embryonic development is a wavelike rhythm of growth and differentiation. Intensification of the processes of differentiation is accompanied by a fall in the rate of growth. Conversely, during periods of particularly rapid growth, the differentiation of morphological systems slows down (Balash, 1967, Katser, 1969, Makhin'ko, 1965 and Fedorov, 1958).

In turn, the growth and development of an organism are associated with a definite redistribution of amino acid reserves. Further, aminotransferases act as key enzymes in catalyzing the oxidative dissociation of amino acids (Lenindzher, 1974).

The object of this investigation was to understand the activity changes of aspartate and alanine aminotransferases (ASAT and ALAT) in minks and blue foxes during the periods of immaturity (two to five months) and sexual maturity (six months).

Blood serum studies were carried out on 143 healthy animals aged two to six months. The ASAT and ALAT activities were determined by A. A. Pokrovskii's ultramicroanalysis method (1964).

An analysis of the results showed that, in two- to five-month old kits, the ASAT activity varied from 65 to 97 units in minks and from 49 to 88 units in blue foxes. The maximum value of this enzyme was recorded at two months of age.

The ALAT activity in two month old minks and blue foxes was 27 and 43 units respectively, and in three month olds 47 and 48 units, the activity of this enzyme dropped to 33 and 28 units in the following two months.

At six months, blue foxes showed a simultaneous increase in the activity of both these transaminases. The ASAT activity went up to 74 units and that of ALAT to 38 units. Among minks of the same age, the ASAT activity was 66 units and that of ALAT 44 units.

It should be noted that the period of juvenility in minks as well as blue foxes was characterized by strictly opposite (mirror inversion) directions of age-wise changes in the enzymes under study. Further, growth was particularly intense (at two months) in light of the high ASAT activity. The intense processes of differentiation (three months) were accompanied by increased ALAT activity.

At six months of age, these directional inversions were absent in blue foxes, but not in minks. This is evidently associated with the earlier maturation of the animals of this species, which have adapted to Trans-Polar ecological conditions.

Thus, the characteristics of transamination reactions catalyzed by ASAT and ALAT reflect a wavelike rhythm in the growth and development processes taking place in the organism.

CHEMICAL PROPERTIES OF THE FAT OF MINKS, BLUE FOXES AND SILVER-BLACK FOXES

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Preservation of the natural characteristics of pelts largely depends on the properties of the fats present in a given species of fur-bearing animal. However, the chemical properties of the fats in these animals have been studied only slightly.

The present investigation studied the fat of blue foxes, minks and silver-black foxes on the Vyatka fur farm. The samples were drawn in November. Subcutaneous fat and the internal fat taken from around the kidneys and intestines were studied. The amount of adipose tissue, the physical and chemical properties of the fat and its fatty acid composition were studied by the method of B N Tyutyunnikov (1966). The fatty acids were studied as methyl ethers using gas chromatography (LKhM-7A Chromatograph). For this 15% polyethylene glycolisophthalate on chromosorb R (100/120 mesh) was used as the liquid phase and argon as the gas carrier.

The methyl ethers of fatty acids were obtained by E A Obukhova's method (1956) using diazomethane.

It has been established that the fur-bearing animals under investigation are characterized by a large accumulation of fat. Thus, the amount of adipose tissue in blue foxes was 23.00 to 28.80% of carcass weight, the corresponding values in silver-black foxes and minks were 12.00 to 17.54 and 12.69 to 16.92%. The maximum deposition of adipose tissue was in the subcutaneous layer of skin (up to 25.9%, of carcass weight in blue foxes, up to 12.9% in minks and up to 12.0% in silver-black foxes).

The author established that, in its chemical properties, the subcutaneous fat of these fur-bearing animals was more indefinite and unstable than the internal fat. The latter has a higher melting point and a low iodine number. The refractive index of internal fat is greater due to the greater concentration of optically active substances in it. The saponification numbers of internal and subcutaneous fat show the greater content of high-molecular acids with 16-18 carbon atoms. The content of low-molecular acids (Reicher-Meissl and Polensky numbers) is insignificant in internal as well as subcutaneous fat. In blue foxes, minks and silver-black foxes, the fat tissue around the internal organs contains more fat than the corresponding subcutaneous tissue. The internal fat of minks is far richer in protein than that of silver-black foxes.

DEGREE OF ALKALINE PHOSPHATASE AND CHOLINESTERASE ACTIVITIES IN YOUNG MINKS AND BLUE FOXES

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It was established earlier by the authors that the serum levels of lactate dehydrogenases, amylases and aspartate and alanine aminotransferases in fur bearing animals vary with the age, season and species (Kozhevnikova, Ostashkova, Meldo and Belyaeva, 1976)

A further study of the serum enzyme spectrum covered the activity of cholinesterase and alkaline phosphatase in juvenile minks and blue foxes

Alkaline phosphatase activity was determined by the microexpress method of Ludd (1964) This method is based on the dissociation of sodium phenolphthalein phosphate by the enzyme, with the liberation of phenolphthalein which produces a crimson color in an alkaline medium The intensity of coloration is proportional to the enzyme activity

Natelson's method (1963) was used to determine cholinesterase activity This method is based on the ability of cholinesterase to hydrolyze choline ethers with the liberation of acetic acid and choline chloride

The serums of 122 clinically healthy minks and blue foxes aged two to six months were investigated

An analysis of the results showed that, with advancing age, the alkaline phosphatase activity in blue foxes decreased from 152 to 30 units Similar changes with age were noted in minks in two-month old kits, the alkaline phosphatase activity was the highest at 73.5 units, but fell to 13.5 units by six months of age These results agree with those given by V P Dektyaev and A.S Kozlov (1974), Meisner (1975), and others, which show that alkaline phosphatase decreases with age in cattle, swine and other animals

The activity of cholinesterase in blue foxes was in the range 18 to 70 units It was highest at three and five months and lowest at four months of age

An increase in cholinesterase activity, from 13-31 units, was noticed in minks aged four to six months

Thus, the early periods of postembryonic development of members of the martens family and foxes were characterized by unidirectional changes in alkaline phosphatase and cholinesterase The activity level of these enzymes was much higher in blue foxes than in minks.

CHEMICAL PROPERTIES OF THE FAT OF MINKS, BLUE FOXES AND SILVER-BLACK FOXES

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The fats under investigation have 19 higher fatty acids with 10-24 carbon atoms. These fats essentially consist of oleic, stearic, palmitic and palmito-oleic fatty acids. The content of other fatty acids is insignificant. In silver-black foxes, the fat around the kidneys consists of 62.8% unsaturated fatty acids, the corresponding values for the fat around the intestines and subcutaneous fat are 66.11 and 72.07%, respectively. In the fat of minks and blue foxes (internal as well as subcutaneous fat), the content of unsaturated acids exceeds 60.0%.

The subcutaneous and internal adipose tissue of fur-bearing animals reveal an identical pattern of fatty acids, but the quantitative proportion of these acids is different. The properties of the two types of fats under study are not exactly the same.

The specific differences in the chemical properties of the fats of minks, blue foxes and silver-black foxes are slight. The unsaturation level of the fat of these animals falls between that of the fat of domestic animals (for example, pig's fat) and wild animals (for example, the fat of muskrats and marmots).

The above information will be useful for improving the technology of the preliminary treatment of pelts and for working out a rational use for the fat of these fur-bearing animals.

MANAGEMENT OF THE FEED BASE AND THE FEEDING OF FUR-BEARING ANIMALS ON THE CONSUMER COOPERATIVE FUR FARMS OF THE FAR EAST

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The consumer cooperative fur farms in the southern region of the Far East produce annually over 70,000 mink and silver-black fox pelts, valued at over three million rubles. In 1976, the six commercial fur farms in the region contained 18,750 female minks and 330 silver black foxes. The effective yield of kits in 1975 was 4.02 per female mink and 4.04 per female silver-black fox, which worked out to 86.6 and 54.9% per head, respectively. This showed the extremely inadequate level of rearing these fur bearing animals.

The feed composition of the animals was determined by the feed base characteristics. The meat-fish group consisted predominantly of fish and fish wastes (75.9%). Meat of farm and wild animals formed 3.5% of the total feed used annually, meat of marine animals and whales 8.9%, and byproducts 11.7%.

The milk based group of feeds consisted of cheese (mostly) and milk, while the grain feeds contained grains, combined feeds, flour and groats bought from commercial organizations. The vegetable feeds consisted of potatoes, cabbage, vegetables and small amounts of wild berries. Almost all farms buy their vegetable feed from the adjoining agricultural farms. Yeasts for use on the farms are supplied by commercial organizations. Fish fat, vitamins and medicines come from 'Zoovetsnab' (zoological and veterinary supply organization).

The annual consumption of feeds on farms in this region is shown in Table 1.

All of these farms used 5,000 centners of meat, 5,150 centners of byproducts and 27,540 centners of fish-based feeds.

The annual requirement of meat-fish feeds was 34,600 centners (in terms of muscle meat), i.e., there was some underfeeding with meat fish feeds. This deficiency was corrected by feeding large amounts of grain feeds, but the latter cannot substitute for the animal protein and essential amino acid needs of these animals.

The average availability of different feeds is: meat fish 89.1% of the recommended norm, milk products 87.5%, grains 106.5%, succulents 44.5%, fish fat 14.1% and yeast 58.2%.

Table 1. Average annual feed consumption on fur farms (in centners)

Farm	Meat and fish, total	In terms of meat	Milk products	Grain products	Vegetables	Fish fat	Yeast	Other fats
Poronaik	14,538.1	11,527.2	331.1	2,174.9	201.1	—	228.2	639.7
Kamenak commercial farm	12,886.6	10,957.1	556.1	1,173.3	668.4	—	82.3	48.8
Komsomolsk commercial farm	5,321.0	4,074.9	230.4	426.6	406.0	—	34.8	26.9
Troutsky commercial farm	1,164.4	886.6	28.7	101.7	41.8	—	10.6	22.7
N-Amursk commercial farm	3,091.0	2,448.3	72.0	348.8	160.3	—	18.4	—
P. Osipenko commercial farm	683.4	532.4	133.0	78.7	144.7	0.6	12.6	1.8
Total	37,687.5	29,826.5	1,351.3	4,304.0	1,662.3	0.6	386.9	739.9

In addition to the above farms, farms of the Central All-Russian Production and Scientific Combine of the Fur Farming Industry and collective farms are also engaged in breeding fur-bearing animals in the southern region of the Far East. The state fur farms in this region use annually (in thousands of centners) meat of marine animals 46.3, horse meat 14.1, meat of other animals 0.5, meat byproducts and blood 90.2 and fish feeds over 650.

In the southern region of the Far East the production of meat-fish feeds for use in fur farming averages annually: meat feed 257,800 centners, including second grade byproducts 97,400, blood 26,400, dry feeds 28,700, edible and commercial bone 97,800 and inedible fish products 6,987,300 centners. The latter includes 4,517,500 centners of fish feed. Thus, 62.5% locally produced meat and 10.3% fish are used in feeding these fur-bearing animals.

The present feed base, when properly managed, should ensure the required feed of the fur farms. However, the shortage of refrigeration capacity, the absence of transport and communications, and the lack of machinery for processing the feeds stand in the way of adequately meeting the requirements of balanced feed.

EFFECT OF DIBASOL ON THE REPRODUCTIVE FUNCTIONS OF MINKS

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It has been established that the administration of Dibasol or other derivatives of benzimidazol increases the nonspecific resistance of animals. Analysis has shown that one of the mechanisms of this phenomenon is the weakening of the reaction of the hypothalamo-hypophyseal-adrenal system to intense external influences (Rozin, 1967). In light of these observations, the authors studied the effect of Dibasol on farm-bred fur-bearing animals.

It has been established that Dibasol, at 1 mg per kg, administered in the feed of male minks in the latter half of rut increased the duration of rut by an average of one day, it also increased the number of mated females and later also the number of kits. Dibasol was given to females at 0.2 and 1.0 mg per kg along with the feed in the latter half of gestation. Following daily administration of this preparation for six days, it was stopped for six days. This 12-day course was repeated until the time of whelping.

The favorable effect of Dibasol on whelping was reflected in a reduction in the number of stillborn kits and a reduction in embryonic mortality. As a result, the number of kits born per female on the farm increased (in different years, the average was 0.4–1 kit). The positive effect of Dibasol could be clearly seen in a special experiment in which gestating female minks received an additional amount of fat with a high peroxide number along with the feed.

PROTEIN NUTRITION OF PEDIGREE FEMALE MINKS

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Rational utilization of the animal protein in the ration of fur-bearing animals is an important problem facing modern fur farmers

The efficiency of feed with a moderate protein content (8-8.5 g per 100 kcal of metabolic energy) and a high fat content (5-5.5 g per 100 kcal) for commercial young minks has been proven by several investigations and by the experience of leading farmers

There have been comparatively few investigations on pedigree animals

In order to study the effect of feed protein level on the reproduction of young female minks, laboratory and field experiments were carried out from 1973 through 1975 in Lesnaya, Beregova, and on the experimental-demonstration farms of the Institute of Fur Farming and Rabbit Breeding

Tests were carried out on standard, sapphire, silver-blue, violet and pastel minks. Two groups of minks of each color (35-60 animals each) were formed. From the time of weaning to the period of reproduction, the young females were reared on rations containing two levels of proteins: 8.5-8.8 g and 10.5-11.0 g per 100 kcal of metabolic energy.

The results of these investigations established that moderate protein feeding (8.5 g per 100 kcal) of young female minks of standard, pastel and silver-blue colors, from the period July 1 to May 1 of the following year, had no adverse effect on their sexual behavior or their reproductive capacity.

When feeding at moderate energy levels (200-230 kcal of metabolic energy per animal per day), the biological importance of protein for pedigree mink females of these colors is high in the winter-spring period and these animals should be given protein at 17.0-19.5 g per female.

The reproductive capacity of sapphire and violet female minks was higher in those given feed mixtures containing 11 g digestible protein in the winter-spring period than in those receiving rations containing 8.5 g protein per 100 kcal feed.

EFFECT OF THE LEVEL OF PROTEIN REQUIREMENT ON THE DENSITY OF THE HAIR COAT IN MINK

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The prevailing norms for the level of protein in the feed of commercial mink juveniles during their growth period require 8.0–9.0 g digestible protein and 4.5 to 5.5 g fat per 100 kcal of metabolic energy. The utility of such a ration from the viewpoint of product quality and economy has been demonstrated by many investigations and by tests carried out on the leading farms. However, some specialists doubt the utility of this measure, they feel that this level of protein feed significantly reduces the density of the hair coat of minks.

Samples for the histological investigations consisted of skin removed from the sacral region of minks immediately after they had been slaughtered. The fixation of samples, preparation of sections, staining and microscopic examination were carried out by the method of M. A. Diomidova, E. P. Panfilov and E. S. Suslin (1970).

It has been established that, regardless of the level of digestible protein in the ration (8 or 11 g per 100 kcal of feed), the density of the hair coat of minks was practically the same. Thus, when on 11 g digestible protein per 100 kcal, the density of the hair coat of standard minks (males) in November was 141.0 ± 4.24 per sq mm and at 8 g it was 140.5 ± 5.25 per sq mm, the corresponding values for pastel minks were 137.0 ± 4.33 and 140.6 ± 3.93 and for silver blue minks 139.0 ± 4.24 and 137.4 ± 3.93 per sq mm.

ACTIVITY OF DIGESTIVE ENZYMES IN COYPUS

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This paper presents the results of investigations on the enzyme activity of the gastro-intestinal tract in coypus. The levels of amylase, lipase, trypsin and invertase were determined in the mucosa of the duodenum, in different sections of the jejunum, in the large intestine and rectum and in the pancreatic tissue. The activity of amylase, trypsin and invertase was determined by the modified method of A M Ugolev (1969) and that of lipase by the method of G K Shlygina et al (1963).

These investigations showed that the amylolytic, proteolytic and lipolytic activities were highest in the pancreatic tissues. Amylase activity was 95.8 ± 1.54 mg per min of dissociated starch. Its levels in the duodenal mucosa, midportion of the mucosa of the small intestine and rectum were almost the same (41.3 ± 2.3 , 45.6 ± 9.5 , and 49.9 ± 2.7 mg per min). In the distal portion of the small intestine and in the large intestine, its level was somewhat low at 36 ± 6.5 and 23.6 ± 4.1 mg per min of dissociated starch.

Proteolytic activity similarly showed high indices in the pancreatic tissues at 0.33 ± 0.021 and 0.15 ± 0.0016 in the photoelectric colorimeter readings, and in the duodenal mucosa 0.26 ± 0.044 on animal and plant substrates. These values of proteolytic activity in different parts of the mucosa of the jejunum and rectum showed an almost identical level of activity of this enzyme, but it was significantly lower than in the pancreatic tissues and the mucosa of the duodenum. The maximum lipolytic activity was in the pancreatic tissue and duodenum (33.7 and 25.3 tentative units), while it was somewhat lower in the mucosa of the small intestine (7.5 tentative units). It was two tentative units in the large intestine and rectum. Studies on invertase activity established that it was highest in the middle and distal sections of the mucosa of the small intestine at 68.7 ± 3.5 and 60.2 ± 2.05 mg% of reducing sugars, its activity was slightly lower in the mucosa of the duodenum and rectum at 46.6 ± 9 and 45.7 ± 1.85 mg% of reducing sugars.

An analysis of the results helps draw the conclusion that the activity of digestive enzymes participating in carbohydrate and protein metabolism is most distinctly manifested in coypus. The level of amylolytic activity in the digestive organs of these animals confirms the significant role of this enzyme in hydrolysis and assimilation of the various carbohydrates used in the feed of these animals.

EFFECT OF THE LEVEL OF FATS AND CARBOHYDRATES IN THE RATION OF YOUNG MINKS ON THEIR PELT QUALITY

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Recent investigations carried out in different countries have shown that young standard minks require 7-8 g digestible protein and 5.0-5.8 g fat for every 100 kcal of metabolic energy content of the ration to ensure the normal growth and development of the hair coat. Further, Russian and other scientists have established that the carbohydrate level can be raised to 30-35% in the feed of young minks.

At the Vyatka fur farm of the VNIOZ, field experiments were carried out to study the influence of different fat and carbohydrate levels in the rations of young standard minks on their pelt quality. Three groups, each containing 40 females and 40 males, were formed. From July through November 1975, the animals received rations containing the following amounts of digestible matter (as a percentage of calorie content): first group—36 protein, 35 fat and 29 carbohydrates, second group—34, 42 and 24 and third group—34, 48 and 18.

In order to study the morphological indices, samples of skin and hair coat were taken from two males and two females of each group after slaughtering. The investigations were carried out by B A Kuznetsov's method (1952). After preliminary treatment, the length, width, weight and thickness of the skin tissue were determined in the male pelts (Table 1).

Table 1 Properties of the pelts of male standard minks

Group	M+M				
	Length, cm	Width, cm	Area, sq cm	Weight g	Thickness of skin tissue, mm
I	72.02±0.73	15.30±0.21	1,105.20±20.9	151.60±5.8	0.44±0.02
II	70.19±0.72	15.04±0.13	1,057.18±16.9	139.9±4.9	0.42±0.01
III	69.15±0.67	14.9±0.20	1,034.40±17.4	131.8±4.9	0.39±0.01

The pelts of the first group of animals, in all of their indices except width, were superior to those of the third group of minks. The results are statistically significant.

Differences in the fat and carbohydrate levels in the rations of minks had no effect on the length of the hair in all groups. No significant differences were seen in the overall density of the hair.

An analysis of the quality of pelts showed that the return per head was 119.72% in the first group of animals, 120.31% in the second group and 100.35% in the third group. These differences were largely due to differences in the sizes of pelts. The first and second groups yielded a greater number of extra large pelts (Table 2).

Table 2 Distribution of male pelts according to size (percent)

Group	Extra large 'A'	Extra large 'B'	Large
I	52.78	41.66	5.56
II	59.38	34.37	6.25
III	36.36	54.55	9.09

The number of normal and defective pelts in all groups was roughly the same (Table 3).

Table 3 Distribution of pelts according to defects (percent)

Group	Normal	Category of defects			Rejects	
		Low	Medium	High	15%	7%
I	52.78	36.11	8.33	2.78	—	—
II	53.11	34.38	9.38	3.13	—	—
III	54.55	36.35	4.55	4.55	2	2

Thus, a higher carbohydrate level and lower fat content in the rations of young minks led to better indices of pelt quality, as reflected mainly in their larger size.

CONCENTRATES IN THE RATION OF MINKS

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Over the last ten years, investigations have been carried out in the Soviet Union on the feasibility of substituting concentrates for fresh meat-fish feeds. The need arose for such tests due to the fact that supplies of fresh feeds were inadequate to meet the requirements of the growing animal population. The use of dry animal feeds not only broadens the feed base but also reduces the cost of feeding. The cost of digestible protein in fish meal is one half that in fresh fish.

The subject of the present investigation is the formulation of concentrate mixtures, which could form the main ration for rearing mink kits. Two balanced dry mixtures were tested in the experiments (Table 1).

Table 1 Composition of concentrates

Component	Mixture 1		Mixture 2	
	weight, g	%	weight, g	%
Fish meal	12.5	48.6	9.1	41.0
Barley flour	8.0	31.2	8.0	36.0
Protein vitamin concentrate	1.5	5.8	1.5	6.8
Fat	3.6	14.0	3.5	15.8
Vitamin preparation	0.1	0.4	0.1	0.4
Total	25.7	100.0	22.2	100.0

Fish meal contained in the mixture analyzed (in percent): water 10, protein 66.5, fat 11.9 and ash 8.2 including sodium chloride 2.0. The volatile fatty acid content of 100g meal was 3.5 ml and the content of amine ammonia nitrogen was 109 mg.

The animals were put on rations composed of concentrate mixtures starting on July 3. For the first 10 days, 30% of the farm ration was replaced by protein in the concentrate mixtures. Since the kits readily took to this feed, the test minks were totally changed over to the experimental ration on July 13. The animals received these dry mixtures up to November 1.

Commercial evaluation of the pelts showed that the percentage of extra large pelts obtained from males reared on fresh feed was lower than that from males of the second group, 80% of whose ration consisted of concentrate mixture 1. It was also lower than that of the third group, 60% of whose digestible protein was given in the form of concentrate mixture 2 (Table 2).

Table 2 Commercial evaluation of mink pelts (percent)

Index	Group		
	I	II	III
Number of pelts	34	40	39
Losses due to defects	17.7	18.2	19.3
Extra large pelts	73.5	95.0	94.9
Income from pelts	104.52	104.88	103.08

Although the pelts of experimental animals were larger in size than those of the control animals, the former showed a larger percentage of defects. As a result, the income based on quality was roughly the same in all of the groups.

Conclusion

1 Two concentrate feed mixtures were formulated and tested in laboratory and field tests.

2 The mink kits readily took to the concentrate feed, grew rapidly, molted on time and yielded good quality pelts, when concentrate mixtures accounted for 77-87% of the metabolic energy or 60-80% of the digestible protein in their ration.

PRODUCTS OF NITROGEN METABOLISM IN MINKS REARED ON FISH MEAL

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Mink kits readily take to rations containing fish meal and their growth is excellent on this. The nitrogenous matter in the feed is broken down into end products and is excreted with the urine. Therefore, the degree of utilization of digestible feed protein can be assessed by studying the final nitrogenous waste products contained in the urine, while the metabolic state of the organism can be judged from the ratio of nitrogenous fractions present in the urine. The more readily the digestible nutrients are absorbed by the tissues and organs of the growing organism, the more rapid will be the growth of the animals.

In order to investigate these assumptions, two groups of mink kits were formed. The control group (40 males and 40 females) received 100% fresh meat-fish feeds, while in the experimental group (40 males and 40 females) 70% of the digestible protein in the feed was of animal origin. The rations were balanced in their vitamin and digestible protein levels.

An analysis of the nitrogenous fractions contained in the urine of minks showed that, on an average, the kits on rations containing fish meal excreted more total nitrogen than did those in the control group (Table 1). This increase was mainly in the form of urea and ammonia.

Table 1 Nitrogen fractions in the urine of minks, excreted per g of weight increment

Index	Weight increment per day, g			
	July 29 through September 2		September 3 through October 21	
	control	experimental	control	experimental
Mean daily increment, g	7.9	7.6	4.4	3.3
Total nitrogen, mg	351.9	348.7	686.3	915.2
Urea, mg	273.4	283.5	522.3	691.9
Ammonia, mg	22.9	32.4	28.1	33.9
Amine nitrogen, mg	8.5	11.2	21.0	25.6
Creatinine, mg	1.1	5.2	11.7	16.5

The growth rate of the experimental kits was slower than that of the controls. The amounts of total nitrogen and the nitrogen fractions were higher in the urine of minks receiving fish meal than in the control group. Consequently, the kits of the experimental group consumed more digestible protein per unit of weight increment than did those in the control group.

Calculations showed no significant difference in the percentage content of urea throughout the period of investigation, though quantitatively the difference was statistically significant. This suggests that the systems responsible for urea synthesis functioned normally in the experimental minks.

This investigation confirmed that, with rations containing fish meal, nitrogen metabolism lay within certain physiological limits and that the biological value of digestible protein contained in the ration can be judged from the nitrogenous fractions excreted in the urine. The more optimal the amino acid ratio of digestible protein, the lower is the amount of urea excreted in the urine.

DETERMINATION OF THE MINERAL COMPOSITION OF THE HAIR OF FUR-BEARING ANIMALS BY THE ATOMIC ABSORPTION METHOD

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The most important problem facing fur farmers is how to improve fur quality, i.e., its physical properties, color, and the elimination of defects. To successfully tackle this problem, it is necessary to understand the structure of the hair coat, its chemical composition and the factors influencing fur quality.

It is known from literature that macro- and micro elements in the hair influence the quality of the hair coat and its pigmentation (Aivazyan, 1962, Tautsin' and Svilane, 1965, Nazarov and Rish, 1966 and 1968, and others). Studies in this regard have not been carried out specifically for fur-bearing animals, even though a number of fur defects in these animals, such as white underfur, brown coloration, hair splitting, brittleness of top hair, etc., have not yet been explained satisfactorily. Possibly these are related to the level of availability (deficiency or excess) of minerals to the organism.

The authors used atomic absorption spectroscopy to determine the mineral composition of hair. This method is based on the absorption of light by atomic vapors. Using this method, the following 11 elements were detected in the hair coat of dark brown minks: Na, K, Ca, Mn, Mg, Li, Co, Ni, Fe, Cu and Zn. Analysis showed that the hair contained large amounts of Na, Ca, K, Zn and Mg (11.5, 8.0, 5.55, 4.17 and 2.3%, respectively, in ash). The remaining elements—Fe, Cu, Co, Mn, Ni and Li—are present in much lower concentrations (0.47, 0.18, 0.02, 0.02, 0.04 and 0.0019%, respectively, in ash).

Na, K and Li were determined by the emission method, while the rest of the elements were determined by the atomic absorption method. A mixture of nitrogenous oxides and acetylene was used to detect Ca and Mg, while a mixture of air and acetylene was used to detect the other elements.

PHAGOCYTIC REACTION AMONG FARM BRED BLUE FOXES

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Immunity against micro organisms is the result of the interdependent, and to some extent interconditional, action of nonspecific humoral and cellular mechanisms among which phagocytosis plays a significant role. In clinical and experimental medicine and in veterinary practice, phagocytic indices are widely used for assessing the protection mechanisms under different physiological and pathological states of the organism.

An investigation was carried out on the phagocytic function in farm bred blue foxes at the Kondopozhsk state fur farm in the Karelian Autonomous Soviet Socialist Republic. The activity of intracellular absorption and dissociation (percentages of leukocytes—neutrophils—in the absorption phase and dissociation of microbial bodies, respectively), and the intensity of absorption capacity (phagocytic number) were studied in 40 day old kits, two-, three-, four-, five-, and six month old kits, and in adult blue foxes.

An analysis of the results showed that phagocytosis changed in relation to age. Thus, the percentage of phagocytic leukocytes seen in 40 day old (47.39 ± 2.64) and two month old kits (51.30 ± 4.46) increased by the third month (to 68.26 ± 2.39 , $P < 0.001$) and remained at that level in four- and five month old kits (67.8 ± 1.7 to 70.77 ± 2.44). It then decreased significantly in the six month olds (50.71 ± 3.02 , $P < 0.01$).

Similar changes with age were seen for the complete phagocytosis indices, which were characterized by a gradual increase in the lytic and bactericidal characteristics of phagocytes toward the third, fourth, and specially the fifth months, and their decrease thereafter.

The dynamics of phagocytic intensity, i.e., the number of microbial bodies per active leukocyte, were somewhat different. At some ages, these values are associated with the absolute number of lobed nucleated neutrophils in the blood. Further, the most distinct rises in the latter, at three months (up to 2.80 ± 0.20 thousand) and at six months (up to 3.10 ± 0.28 thousand), were accompanied by a reduction in phagocytic number (on an average up to 2.68 ± 0.14 and 2.89 ± 0.17 , respectively).

There are also seasonal differences in phagocytic activity which, in fully mature animals, are probably associated with the seasonal biological cycles.

The number of phagocytes taking part in absorption varies throughout the year from 39.0 ± 2.34 to $57.43 \pm 6.9\%$, the phagocytic number from

2.57 ± 0.13 to 6.36 ± 0.84 , reaction completion from 14.25 ± 2.68 to $41.0 \pm 6.66\%$ and the absolute number of leukocytes (neutrophils) from 1.68 ± 0.15 to 3.57 ± 0.29 thousand. The ability of an organism to sustain phagocytic activity, and hence intracellular 'digestion', at an optimum level, i.e., a relatively high average number of neutrophils in the blood, corresponds to comparatively low values of their phagocytic capacities.

Antiphase changes render an analysis of the data difficult. Nevertheless, it can be seen that a high activity level in spring is a characteristic feature of the phagocytic reaction in blue foxes. This is most clearly seen when converting the relative indices of phagocytosis into absolute values, since then the overall effect of the phagocytic function can be perceived.

Thus, the activity of phagocytosis in blue foxes differs with the age of the animal. It also varies seasonally. The age and seasonal dynamics noticed reflect the complex nature of the metabolic transformations that occur during the growth and development of the blue fox organism, and also during its seasonal adaptations.

A COMPARISON OF PHAGOCYTOSIS IN MINKS AND BLUE FOXES DURING DIFFERENT SEASONS

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The present study is devoted to an investigation of the cellular factor of nonspecific immunity—phagocytosis—in standard minks and blue foxes during different seasons of the year

It has been established that, in minks, the number of leukocytes present in the phagocytic phase was equal to $49.56 \pm 3.09\%$ in spring, $35.64 \pm 1.43\%$ in summer, $45.93 \pm 4.47\%$ in autumn and $25.00 \pm 2.21\%$ in winter. Similar seasonal dynamics have been detected for the indices of complete phagocytosis (percentage of leukocytes taking part in the destruction of microbial bodies). Each of the active leukocytes absorbs a somewhat larger number of microorganisms in winter and autumn (3.31 ± 0.20 and 2.20 ± 0.15 , respectively) than in spring and summer (1.86 ± 0.06 and 1.75 ± 0.05).

The maximum absolute number of lobed neutrophils in the blood was recorded in spring and summer (4.29 ± 0.41 and 3.00 ± 0.29 thousand). The minimum number was in autumn (1.69 ± 0.21 thousand). The winter season is intermediate in this respect (2.77 ± 0.26 thousand).

Phagocytosis in blue foxes is characterized by a higher percentage of absorbing leukocytes (51.07 ± 2.32 and 49.68 ± 3.42) and digestive leukocytes (29.53 ± 4.34 and 28.47 ± 2.68) in spring and summer than in winter (42.76 ± 2.13 and 15.12 ± 2.19). Further, in winter the low number of leukocytes participating in intracellular 'digestion' in blue foxes as well as minks corresponds to a significant level of their absorption capacity (6.31 ± 0.50).

The seasonal variations in the absolute number of lobed neutrophils in the blood of blue foxes are very similar to the corresponding dynamics in minks.

Thus, the study of phagocytosis in minks and blue foxes established the seasonal dynamics of the main indices which determine the efficiency of this protective reaction. On the whole, minks and blue foxes have a comparatively high level of phagocytosis in the spring. Among these fur-bearing animals, a variable type of phagocytosis has been identified and is probably due to their specific differences. A comparatively low level of phagocytic capacity and a fairly high degree of digestion are characteristic of phagocytosis in adult minks. In blue foxes, a relatively low lytic and bactericidal action of leukocytes corresponds to a very intense phase of their seizure.

EFFECT OF LEVEL OF FEEDING ON THE REPRODUCTIVE CAPACITY AND FATNESS OF SILVER-BLACK FOXES

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Work on the leading state fur farms has demonstrated that a good run of the period of heat, high fertility of females, yield of numerous and healthy offspring, and their survival are ensured by wholesome feeding of the stock.

Long-term observations (1964 to 1975) of the feeding of silver-black foxes on the Pokrovsk fur farm of the Yakutsk consumer cooperative farm revealed significant differences in the energy values of rations in years when a high or low number of young were recorded

In the period of preparation for the estrous cycle in 1968, 1969, 1974 and 1975, when test silver black vixens yielded 3.90 to 4.27 kits each, the feed consumption from July to February averaged 151,500 kcal (July 560,000, August 570,000, September 695,000, October 600,000, November 700,000, December 690,000, January 590,000 and February 575,000 kcal). Further, 49.2% of the feed was consumed in the first four months. In years when the kit yield was 3.0 to 3.3, the energy content of feed intake in the corresponding period was 88.7% of the above four-year average figure and only 39.6% of the feed was consumed in the period from July to October. Excessive feeding of silver-black foxes from November to February and scanty feeding in the summer-autumn months did not increase the yield of kits.

The readiness of silver black vixens for reproduction is judged on the farm from their weight in early January. However, a more objective criterion is the index of their fatness (ratio of the live weight of the animal in g to its length in cm).

For silver-black foxes on the Pokrovsk farm this index varied widely (66-125), the index of fatness decreasing as the size of the animal increased. Such changes were noticed in adult as well as young individuals thus showing that there is no need for a differentiated approach to the feeding of large and small fur-bearing animals. At the same time, the reproductive capacity of these foxes varied in relation to the degree of their fatness. The maximum yield of young, the lowest percentage of females remaining sterile and the lowest mortality among young were noticed in specimens whose indices of fatness varied from 86-99. When the index deviated from this range, the reproduction capacity of silver black foxes was impaired. But early mating and high fertility and yield were noticed in females whose fatness indices were high by January but dropped 15-20% by the time of mating.

In order to achieve the optimum indices for the yield of young, the energy value of the rations in the periods of rest and preparation for the estrous cycle should be not less than 150,000 kcal. Further, the unique features of preparation for reproduction under the sharply continental climatic conditions in Yakutsk call for a proper distribution of feed energy in different seasons.

The feeding of silver-black foxes in accordance with their size and the control over their weight indices (by measuring and weighing on October 1 and January 1) allows for timely fattening of slow-growing animals and slimming of those prone to fatness.

EXCESSIVE USE OF GRAINS AND VEGETABLES IN THE FEED OF YOUNG SILVER-BLACK AND BLUE FOXES

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The rations used on many farms for rearing young silver-black and blue foxes intended for slaughtering provide for abundant meat-fish or fish-meat feeding in the period of rapid growth and a reduction in the energy level of the feed in autumn, when the level of animal protein is uniformly maintained at a high level. Such rations are usually expensive. The scope for enlarging the pelt size by resorting to this type of feed is limited for two basic reasons: overfeeding to increase the animal size by feeding them rations rich in animal protein in autumn increases the number of defects in the hair coat, moreover, it leads to a sharp increase in product cost.

How then to increase pelt size and improve product quality, while simultaneously reducing the cost? In the present investigation, the course followed was greater utilization of carbohydrate feeds in the rations of the young, than what is ordinarily used in autumn. It should be pointed out that the intense use of grain feeds and vegetables in autumn calls for a corresponding summer preparation for the young. In summer, when the young grow immensely, the amount of grain and vegetable feeds should correspondingly constitute 10-14 g and 6-8 g per 100 kcal of feed, so that the overall concentration of carbohydrates is approximately 25-30% of the calorie content of the rations, with 9-10 g of animal protein per 100 kcal.

Such a preparation for the young in autumn from 1972 up to 1974 helped raise the quantum of grain feeds from 24 to 25 g per 100 kcal of feed, and that of vegetables to 20 g. The overall concentration of carbohydrates was increased by using mixed feeds and vegetables for 50% or more of the calorie content of the rations, while reducing the intake of animal protein to 6.5-7.0 g per 100 kcal.

Mixed feed was given mostly in a dry form and consisted of 70% wheat, 10% wheat bran, 10% sunflower cake, and 10% edible yeast (hydrolytic). These rations, which are rich in carbohydrates but poor in protein, enable a high calorie level to be maintained in autumn, and favorably influence the size of pelts, their quality and cost.

The cost of raising young silver-black and blue foxes in 1974 was 67 rubles 40 kopeks and 50 rubles 36 kopeks, respectively. The average realization price of the pelts of silver-black and blue foxes was 99 rubles 40 kopeks and 85 rubles 45 kopeks. The degree of profitability thus went up to 45 and 66%, respectively, for silver-black and blue foxes.

In the present investigations, it was decided to study the reproduction of pedigree animals reared up to December on rations with a high carbohydrate content and a low protein content. The principal indices of reproduction among young silver-black and blue foxes reared on such rations in 1974 were much higher than those of females born in 1973 although they too were reared on rations with a high protein content. For the year 1975 as a whole, in one herd of silver-black foxes, 4.7 kits were produced per female against 4.2 in 1974. The corresponding values for blue foxes were 8.03 in 1975 and 6.88 in 1974. Further, the increase in litter size was mainly due to young females, although the male functioning also remained satisfactory.

Thus, rations rich in carbohydrates can be used in autumn even for young pedigree animals.

This investigation has shown that, after ensuring intense growth in summer, young silver black and blue foxes can be fed in autumn at less than the recommended levels (mean daily calorie value) without loss of quality or decrease in the size of the pelts. Further, in this case, too, rations enriched with carbohydrates, but with a lower protein content, can be successfully utilized.

Diseases of Fur-bearing Animals

PATHOMORPHOLOGICAL CONFIRMATION OF THE SPECIFICITY OF IMMUNOELECTROOSMOPHORESIS DURING ALEUTIAN DISEASE IN MINKS

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Until recently, conclusive diagnosis of Aleutian disease (AB) could be carried out accurately only by postmortem or pathomorphological investigations. Therefore, the present study was undertaken to determine the diagnostic value of immunoelectroosmophoresis reaction (RIEOF) using an indigenously produced antigen (V S Slugin and M I Chebotarev).

The study covered the liver, kidneys, spleen, and lymph nodes of 55 killed minks with positive and negative RIEOF. These included sick animals and those in which the disease was experimentally induced.

In 47 cases (85.5%), the presence or absence of pathological and histological changes coincided with the RIEOF indices. The serological diagnosis for AB using RIEOF confirmed the disease in 36 out of 40 minks (90%). AB was not confirmed in only four minks (10%). Further, pathomorphological changes characteristic of AB were detected in four others out of 15 minks with negative RIEOF (26.7%).

Individual differences are explained, firstly, by the high sensitivity of RIEOF which can detect antibodies in minks even on the seventh day after infection when pathomorphological changes have not yet had time to develop and, secondly, by the nonpersistent course of the disease when clinical symptoms and anatomical changes are absent in the minks, while the RIEOF is positive (Hartsough, 1976).

In most minks with a positive RIEOF, the pathological and histological changes identified were typical of the latent forms of AB and were characterized by the presence of isolated or numerous accumulations, predominantly lymphoid, in the interstices of the liver, kidneys (more rarely), lymph nodes, and spleen. In some minks with a positive RIEOF, cell proliferation was accompanied by cholangitis and the deposition of PAS-positive material in the cavities of the renal glomeruli and tubules. The livers of the four minks with positive RIEOF showed accumulations of lymphoid cells only along the sinusoid. In our opinion, this was insufficient for a pathomorphological diagnosis of AB.

Under negative RIEOF conditions, pathological changes were absent in the majority of minks, but a few lymphoplasmocytic proliferate in the kidneys, liver and spleen, chronic interstitial nephritis in the kidneys, and lymphocytosis in the spleen and lymph nodes were detected in four minks.

Thus, the results of RIEOF and pathomorphological investigations for AB coincided in the overwhelming majority of minks, thus confirming the specificity of RIEOF in diagnosing AB in these fur-bearing animals.

AMINO ACID COMPOSITION OF THE SERUM IN BLUE FOXES WITH INDUCED INFECTIOUS HEPATITIS

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Prolonged viral action on the liver produces in the organism a distinct viremia. The longer the virus circulates in the blood, the greater is the chance that biochemical changes in serum amino acid will take place due to the influence of the pathogen. Data on amino acid changes in the blood serum would therefore be of great scientific and practical interest in the diagnosis and study of the pathogenesis of diseases.

The present work was carried out at the Institute of Fur Farming and Rabbit Breeding and the Ivanovskii Institute of Virology, Academy of Medical Sciences, USSR. The amino acid composition of blood serum in healthy blue foxes, as well as in those with induced infectious hepatitis, was investigated by chromatography on ion exchange resins using an automatic analyzer.

We identified 14 amino acids in the blood serum of clinically healthy animals. These results were later compared with the amino acid composition of the serum of blue foxes infected with the "PS 2" strain of the infectious hepatitis virus.

For chromatographic analysis of the serum, 6 ml of serum was mixed with 12 ml acetone, thoroughly shaken, and centrifuged at 3,000 rpm for 15 min. The centrifuged deposit was mixed with 6 ml acetone and centrifuged a second time under the same operational conditions. The serum thus processed was evaporated in a drying chamber at 60° for 6 hr. The dried residue was diluted to 3 ml, with a citrate buffer of pH 2.2, filtered, and 2.0 ml charged in the column. Fractionation of the amino acids lasted for 18 to 25 hr.

A comparison of the amino acid composition of the blood serum of clinically healthy animals with that of sick animals showed, that, in the latter, the threonine level rose by 0.42 mg%, serine by 0.55, glycine by 0.28, tyrosine by 0.33 and cysteine acid by 0.73 mg%.

The amino acids proline, methionine, and isoleucine disappeared altogether while the content of valine (by 0.31 mg%), aspartic acid (by 0.15 mg%), glutamic acid (by 0.4 mg%), and leucine (by 1.31 mg%) the blood serum of sick animals as compared with the normal values.

Based on these results, it can be concluded that, under the influence of the infectious hepatitis virus, the overall metabolism of the organism was disturbed. This in turn led to the total disappearance of some amino acids from the blood serum and the increase or decrease of others.

It is known from the information available in literature that the total amino acid level of serum is usually high when the liver is infected, since deamination occurs essentially in the liver.

PARASITES OF FARM-BRED BLUE FOXES IN KARELIA

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The intensive development of fur farming in Karelian has provided an impetus to parasitological investigations of fur bearing animals. The present work forms a part of the complex investigations into the pathogenesis of parasitic diseases among farm bred blue foxes.

Blue foxes were investigated in July 1976 at the Pryazhinsk state fur farm and from August through December 1976 at the Kondopozhsk state fur farm. The study covered 239 blue foxes of which 184 were from the latter farm and 55 from the former farm.

Coprological analysis using the Fulleborn method (Ivashkin et al, 1971) was carried out to identify the invasions.

The parasites of blue foxes included Protozoa (Coccidians—*Eimeria* sp.), parasitic nematodes (*Strongyloides* sp.), and roundworms (*Toxascaris leonina* sp.). Coccidians and Strongyloids were detected for the first time in the Karelian blue foxes.

On the Pryazhinsk state fur farm, 3.6% of the animals were infected with Coccidians, 10.9% with Strongyloids, and 29% with Ascarides.

On the Kondopozhsk state fur farm, 10.6% of the blue foxes were infected with Coccidians and 32.7% with Strongyloids. Roundworms were detected in 48% of the animals.

On this farm, additional investigations were carried out on seasonal variations in the parasitic fauna of farm bred blue foxes. In August 1976, their rate of infection with Coccidians was 10.6%, Strongyloids 32.7%, and Ascarids 48%. By October the rate of infection had decreased. Strongyloids were detected in 9% of the animals and *T. leonina* in 15%, while Coccidians were not detected at all. Coprological analysis carried out in December did not reveal any parasites.

Thus, parasitic infection of blue foxes is high. This may be associated, on the one hand, with inadequate epizootiological prophylactic measures (cleaning and disinfection of the cages) and, on the other, with the brief growth period of larval phases before invasion (2 to 4 days) which makes for regular autoinfection among blue foxes. The level of infection of these animals varies depending on the season and hence a detailed study of the seasonal dynamics of parasite fauna in blue foxes should be undertaken.

MORPHOLOGICAL CHANGES IN TKHORZOFRETKAS* VACCINATED AGAINST CANINE DISTEMPER

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While evaluating the reactive and immunogenic properties of vaccine preparations, the various abnormalities resulting from their use will have to be taken into account using complex methods. Morphological and histochemical investigations play an important role in this respect.

The purpose of the present investigation is to study the dynamics of morphological changes in the organs of tkhorzofretkas immunized by aerosol or subcutaneously with the canine distemper vaccine of strain "EPM" and compare them with the other indices of immunological disturbance during the growth process of immunity in the organism.

Tests were carried out on five to six month old animals immunized by aerosol or subcutaneously at 100 TTsD₅₀** Aerosol vaccination was given in a static chamber of 1.02 cu m using the aerosol generator SAG-I-RN at an ambient temperature of 18-20° and a humidity of 70-85%.

Morphological investigations were carried out on the organs of 18 animals killed 1, 3, 7, 10, 14 and 21 days after vaccination. The spleen, lymph nodes, lungs, heart, liver, kidneys, adrenal glands, and gastro intestinal tract of these animals were removed for investigation. The organ samples were fixed in Carnoy fixative and embedded in paraffin, the sections were stained by the Brash method.

At the time of collecting the organs, blood samples were drawn for serological investigation. The complement fixation (RSK) and neutralization tests were carried out by well known methods. Autopsy within the first three days after vaccination failed to establish any changes in the animals. Histological investigations revealed enlargement of the embryonic areas of lymph follicles of regional lymph nodes, enlargement of these lymph nodes, increased pyroninophilia, and mitotic activity of cells.

Slight aggregations of pyroninophilic cells and catarrhs of sinuses were seen in the medullary cords and around the vessels.

In the spleen and isolated lymph nodes, there were only active cells of reticuloendothelium. In the lungs of animals exposed to aerosol vaccination, there were slight hyperplasia of the peribronchial lymphoid tissue and small aggregations of pyroninophilic cells in the subepithelial tissue of the bronchi.

* Local name for the Siberian polecat *Mustela putorius furo*—General Editor

** Titration pathologic dose—General Editor

Immunomorphological disturbances in the lymphoid organs were most pronounced from the seventh to the tenth day after vaccination. This was seen on autopsy as enlargement, increased succulent nature of the lymph nodes, particularly the regional ones, and, under the microscope, as sharp hyperplasia of lymphoid tissue of immunocompetent organs, a significant rise in the number of young lymphoid-plasmocytary tissues, and eosinophils. They accumulated in the form of extensive focal fields or diffused. Microfocal accumulations of plasma cells were also noticed in the lungs, liver and kidneys. By the 14th day, some cells of the proliferate underwent dystrophy and necrosis, thus confirming the extinction of the reactive processes. By the 21st day after vaccination, the structure of the lymphoid organs had normalized in most animals.

Serological investigations after aerosol vaccination revealed complement fixative and neutralizing antibodies on the seventh day in titers 1:4 to 1:8. After subcutaneous vaccination, the complement fixative and neutralizing antibodies were seen on the seventh and tenth day. The maximum titer of antibodies after aerosol vaccination was on the tenth day and after subcutaneous vaccination on the 14th day (1:16 to 1:32). It may be assumed that, after aerosol and subcutaneous immunization of tchhorzofretkas by "EPM" strain vaccine, similar morphological changes take place in the immunocompetent organs. However, after aerosol vaccination, a more distinct immunomorphological reaction was noticed in the lungs of test subjects. The maximum reaction variations were from the seventh to the tenth day after immunization, which coincided with the presence of complement fixative and neutralizing antibodies in the blood. It should be pointed out that the vaccine did not result in any irreversible necrotic or inflammatory changes in the organs of these animals.

MORPHOLOGICAL CHANGES IN THE BRAINS OF MINKS SUFFERING FROM ENCEPHALOMYELITIS

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These investigations were based on tissue samples drawn from different sections of the brains of six dead minks on fur farms in the Krasnoyarsk region.

The disease was manifested in nervous symptoms such as anorexia, gait disturbances and progressive apathy.

The infected material was fixed in a 10% solution of neutral formalin and sealed in paraffin. The sections were stained with hematoxylin-eosin.

Hematological investigations showed that pathological changes were localized mainly in the neurons of the subcortical region and in the intercellular cerebral matter. They were also detected in the cerebellum, midbrain, pons varolii, and optic thalamus. Thus infection took a degenerative necrotic (noninflammatory) form, such as vacuolar dystrophy of the nerve cells.

Isolated or abundant vacuoles of different sizes and shapes were seen in the infected cells. Most characteristic were the large vacuoles, which covered almost the entire cell. In such neurons, the cytoplasm was in the narrow region along the cell periphery, as a result of which the cells looked like a tennis racket.

Some cells were of smaller volume, homogenized with uneven (fringed), weakly stained contours (diffused), and deformed. The peripheral spaces of such cells were greatly enlarged and at places contained pale pink, thin fibrils or a network (edema). Many neurons were hardly visible or altogether absent (total lysis). Further, hemorrhages and extensive perivascular edema were noticed.

The gray matter suffered from intense vacuolization and softening as a result of which it acquired a porous (spongy) form. Inflammatory phenomena were not detected. Widespread edema of the cerebral matter, vacuolization of the neurons, and their disintegration are a consequence of deep seated disturbances in the penetrability of cerebral vessels. Apparently this is caused by proliferation of the causative organism in the endothelium of the vessels.

The changes described above were noticed in all of the cases studied and they can be used for diagnosing encephalopathy.

ALEUTIAN DISEASE IN MINKS AS AN EXPERIMENTAL MODEL FOR STUDYING THE PATHOGENESIS OF SYSTEMIC LUPUS ERYTHEMATOSUS

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In the present investigation a study was undertaken on the nature of morphological changes in minks suffering from Aleutian disease (AB) these were compared with similar phenomena in human beings suffering from systemic lupus erythematosus (SKV) The studies were carried out on kits and adult minks infected spontaneously and experimentally In all 36 animals were investigated Since the changes in the spontaneously and experimentally infected animals were of same type and extent of localization the discussion is in general terms The most common morphological symptom of the disease in minks was the plasmocellular infiltration of organs and tissues, which was seen in varying degrees Investigations of experimentally infected kits killed one, two and three months after infection showed that this plasmocellular reaction was the earliest symptom of the disease

Changes in the kidney were quite diverse and resembled those occurring during lupoid membranous glomerulonephritis In the glomerulus there were thickenings and homogenizations of basal membranes staining with eosin and containing PAS positive material in the form of 'wire loops' characteristic of lupus nephritis In the animals which died of AB or those killed in the late stages of the disease, there were partial or total sclerosis and hyalinosis of the glomeruli These were manifested by coarsening and sclerosis of the stromata accompanied by dystrophy and atrophy of the epithelium of renal tubules The cavities of the tubules were broadened Hepatic changes were permanent, though less clearly manifested than renal ones The former were characterized by granular and vacuolar dystrophy or death of hepatic cells and proliferation of bile ducts However, experiments on the infection in kits showed that, during the initial stages of the disease, morphological changes were more distinct in the liver than in the kidneys

Lymph- and plasmocellular infiltration and accumulation of macrophages in the spleen and lymph nodes and megacaryocytes in the spleen were invariably detected Many vessels were in a state of fibrinoid swelling and the endothelium of the vessels was activated The productive reactions in vessels were moderate

The nature of glomerulonephritis and embryonic changes, fibrinoid changes in the vessels, and lymph-plasmocellular reaction are definitely similar to the corresponding features in human beings suffering from SKV. Along with this similarity there were also pronounced differences in the types of morphological changes. The difference lay primarily in the absence of disorganization of the connective tissue in the animals. Nevertheless, the similarities noticed suggest that there are similarities in some pathogenic mechanisms of the infection of organs and tissues. These would be of interest in planning a study on these mechanisms in experimental animals.

ROLE OF NUCLEOTIDES IN THE ETIOLOGY OF UROLITHIASIS IN MINK

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Urolithiasis in minks is widespread on fur farms and it results in significant economic damage. Adult animals and young standard and colored minks fall prey to this disease. Investigations have shown that the renal pelvis was often filled with mucus. This thickened compound is a protein compound of a complex nucleoprotein type, containing purine bases, ribose and organic phosphorus. The amino acids in the compound were analyzed by chromatography. These were mainly lysine, arginine, histidine, and aspartic and glutamic acids. This compound carries a positive charge and has distinct alkaline properties (pH 7.55-9.0), dissolves well in strong bases (15% NaOH), and coagulates with the addition of hydrochloric acid. With 10% HCl it coagulates and loses its viscous consistency.

The urinary concretions in minks are mainly of a phosphate-carbonate type. They contain calcium, magnesium, and ammonium phosphates and, to a lesser extent, potassium phosphate, and calcium and magnesium carbonates. Sulfates have also been recorded. Over half of them ($50.9 \pm 0.7\%$) consist of organic compounds, which burn on calcination. The nucleotide and amino acid compositions of uroliths are identical to the nucleoprotein composition in mucous secretions, thus confirming their role in the formation of concretions.

When studying the urine of clinically healthy minks, the disintegration products of nucleotides have been detected: purine bases, phosphoric acid and ribose. However, these are found in the free state. In mucous secretions and in the organic matrix of uroliths, there are compact nucleotides which combine with the amino acids. The latter do not have the proper protein structure (since their amounts are not identical) but evidently represent the residue of the enzyme phosphatases (nucleases or nucleotidases). The peptide chain of ribonuclease alone consists of 126 amino acids, the rest have 18 free amino groups and one carboxyl group, which is responsible for the distinct alkaline properties of this nucleoprotein.

Since enzyme activity is disturbed when the phosphatase remains firmly combined with the nucleotide, the nucleoprotein molecules are crystallized in the form of long needles. They take on the properties of poly-electrolytes.

These long molecules are of great importance in the etiology of the disease. While globular proteins, especially serum albumin which has a molecular weight of 70,000, cannot pass into the urine, the molecules shaped like a

needle, and thus of smaller diameter, can penetrate easily. The molecular weight of ribonuclease is not high (15,000) and the nucleoprotein containing it enters the urine easily. The filamentous shape of the molecule of this nucleoprotein is confirmed by the sharp loss of its viscosity under the action of strong acids, in the same way as they act on copolymers of polylysine or polyglutamic acid.

The elongated shape of the molecule during protein passage through the glomerulus cells renders the filtration difficult and damages them. On the rupture of glomerulus cells, the formative elements of blood (erythrocytes, leukocytes, etc.) also pass into the urine. Proteins and amino acids in the primary urine are actively absorbed by the glomerulus cells and convoluted tubules. When filamentous molecules of nucleoproteins are formed and intertwined, this process becomes impossible. They form a compound-like thickened mucus as a result of accumulation in the urine. The nucleoprotein, with a distinct alkaline reaction, causes inflammatory phenomena in the urinary bladder (cystitis) and changes the surface tension of urine, resulting in under wetting of the animals.

The mechanism of subsequent stone formation is associated with the molecular reaction between nucleoproteins, which have the properties of a copolymer, and the electrolyte ions present in the urine. As a result of incomplete oxidation of purine base (adenine), urate, xanthic acid, and indigo, stones can form. Moreover, the combination of the ions of magnesium, calcium, and other metals to the active centers of amino acids facilitates the formation of phosphates, carbonates, sulfates and oxalates.

The disturbances in nucleotide metabolism, which are associated with a weakening of the acidic or basic phosphatase activity in the organism, form the basis of urolithiasis in minks.

RESULTS OF IMMUNIZING FUR-BEARING ANIMALS WITH LP-MOSCOW VACCINE IN THE LATVIAN S S R

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Live cultures of vaccines prepared on diverse cellular substrates are used to immunize animals against canine distemper. Outside the Soviet Union, cultures of the cells of leukemia-free chicks and the kidneys of specially bred dogs are used for this purpose. In the Soviet Union, the vaccine is made from the cultures of cells of chicks and kidneys of monkeys or dogs.

In 1974, the Moscow Institute of Virus Preparations and the Institute of Fur Farming and Rabbit Breeding, Ministry of Agriculture, Russian Soviet Federative Socialist Republic, produced a new strain of canine distemper vaccine, EP-Moscow. This new vaccine against distemper is kept under strict control to ensure the absence of extraneous viruses or contaminants.

On fur farms of the Latvian Soviet Socialist Republic, the EP-Moscow strain of vaccine has been used in extensive field tests since 1975. Minks and blue and silver-black foxes are vaccinated in the usual periods, and in accordance with the instructions for the use of this vaccine.

Over the period of observation (two years), no adverse effects have been noticed, even when the vaccine was administered in the winter.

The antigen activity of the vaccine was studied four months after vaccination, i.e., in the period of maximum possible reduction of antibody titer. Three or four weeks after immunization, when there was maximum accumulation of antibodies in the fur-bearing animals immunized with the ASL (American) and LP-Moscow vaccines, the antibodies were determined in the titers 256 and 128, respectively, and 64 in those immunized by KF-668.

At the time of slaughtering the animals, blood samples were selectively drawn. The serum was heated to 56°C for 30 min. The antibodies produced against the canine distemper virus were determined by studying the neutralization reaction of the pathological effect of the virus in a culture of embryonic cells of Japanese quails, using the method developed at the Moscow Institute of Virus Preparations.

In standard minks given the EP-Moscow strain of vaccine, the reduction in antibodies was minimal, and the average geometric titer was 98. In colored minks, the reduction in antibodies was more prominent and the antibody titer ranged from one-third to one-half the level determined in the serums of standard minks; it averaged 36-45.

In the blood serum of animals inoculated with the standard American vaccine, the antibodies of canine distemper were determined in similar titers in standard minks it was 89 and in colored minks 42-50. In animals vaccinated with the KF-668 vaccine, the antibodies were determined in a low titer, irrespective of color ($\leq 4-8$).

In a limited number of animals (in separate brigades), simultaneous immunization against distemper and botulism was studied, while administering iron and vitamin preparations. It was demonstrated that the simultaneous administration of these two vaccines is possible. If vaccination against botulism was not given at the appropriate time, i.e., on the 45th day after birth, the minks can be simultaneously vaccinated on the 60th day, with the two vaccines in the usual doses. Immunization with the EP-Moscow vaccine can be successfully combined with the administration of iron and vitamin preparations.

During the period of investigation (1975 and 1976) in Latvia, the EP-Moscow vaccine was found to have a high epizootological effectiveness, it was in no way inferior to the American ASL vaccine. In Latvia, there has been a high incidence of canine distemper, especially in the Riga and Liepaja regions. In 1975 and 1976, however, the disease was not detected among the vaccinated animals.

Based on these results, since 1976, use of the EP-Moscow vaccine has been recommended in Latvia for immunizing the main populations of fur-bearing animals. This helps to save resources that would be required to import vaccines.

LIPID CONTENT OF THE LIVER AND MUSCLES OF NORMAL AND DIPHYLLOBOOTHRIASIS AFFECTED BLUE FOXES

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Diphyllobothriasis is a serious affliction of blue foxes, which causes various types of functional disorders associated with metabolic disturbances (Berestov, 1971)

This paper presents the results of a study on the lipid content of the liver and muscles in blue foxes (females and seven-month-old kits) experimentally infected with broad tapeworm (*Diphyllobothrium latum*), as well as in animals free of this infection

The material was collected during large-scale slaughtering of blue foxes in October-November 1976, on the Kondopozhsk state fur farm. The samples were fixed using chloroform-methyl alcohol (2:1). The lipid content of the tissues was determined by the standard methods (Folch, 1957 and Sidorov et al., 1972).

It was found that the liver of normal adult animals contained 2.3 times more lipids and the muscles 1.6 times more lipids (on a dry weight basis) than the corresponding tissues of the kits. The results were similar for individual fractions of total lipids (phosphoacylglycerine, triacylglycerine, and cholesterol).

In adult females suffering from diphyllobothriasis, the total lipids were 5.5% lower in the liver and 7.6% lower in the muscles, compared with the controls. The concentration of the main lipid components decreased similarly.

In infected kits the lipids were 2.6% higher in the liver and 2.3% higher in the muscles than in the control kits. There was a quantitative increase in all of the lipid fractions in the tissues of sick animals.

It is clear that the presence of broad tapeworm in the intestines of blue foxes influences the lipid metabolism of the animals, but the reactions of different age groups to invasion by these helminths are not the same.

IMMUNOGENESIS OF COMBINED VACCINATION OF MINKS AGAINST BOTULISM AND CANINE DISTEMPER

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These tests were carried out on 48 mink kits aged 45 days, divided into four groups of 12 each

The minks of the first group were vaccinated by a complex method against botulism and canine distemper, the second group against botulism alone, and the third group against canine distemper alone. The animals of the fourth group were not vaccinated

The total protein and protein fractions in the blood serum of test animals were determined twice before immunization, at intervals of two or three days, and on the 5th, 10th, 15th and 21st days after inoculation. At these times, as well as one, two, four and six months later, the presence of specific antibodies in the blood serum was studied (botulinic antitoxin and antibodies neutralizing the distemper virus)

On the tenth day of the investigations, after a single vaccination of minks, a statistically significant increase in total protein (6.64 ± 0.05 g%, initially 5.91 ± 0.12 g%) was established. By the 21st day, the amount of total protein dropped to 6.35 ± 0.10 g% ($P > 5$). The increase in total protein was at the expense of globulins. Further, a statistically significant increase in the gamma-globulin fraction was noticed on the 10th and 15th days after immunization (0.76 ± 0.02 g%, $P = 2$ and 0.76 ± 0.03 g%, $P = 5$) and of beta-globulin 10 days after inoculation (1.53 ± 0.05 g%, $P < 0.1$). The increase in alpha-globulins in the blood serum to 0.98 ± 0.04 g% ($P = 2$) occurred on the 5th to the 15th days of the investigations. No statistical significance was found in the reduction of the albumin fraction.

Similar changes in the serum protein spectrum were noticed after a single vaccination. In minks vaccinated only against botulism, a significant increase in total protein was noticed 15 days after vaccination (6.64 ± 0.13 g%, $P = 5$, original value 5.97 ± 0.16). At the same time, there was an increase in the total protein level in minks immunized only against distemper (6.75 ± 0.07 g%, $P < 0.1$). An increase in globulin fractions was simultaneously established. Among minks vaccinated against botulism, a significant increase in beta-globulins occurred on the 10th and 15th days after immunization, from 1.22 ± 0.10 g% to 1.41 ± 0.08 g%, $P = 2$ and 1.57 ± 0.06 g%, $P = 1$).

Among the third group of minks vaccinated against canine distemper, the beta-globulins showed a significant rise in 5 and 10 days to 1.49 ± 0.07 g%,

$P=3$ and 1.51 ± 0.05 g%, $P < 0.01$ Ten days after vaccination, among the second and third groups of minks, some rise in the alpha globulin fraction was established (to 0.95 ± 0.03 g%, $P=3$ and 1.07 ± 0.02 g%, $P=0.1$, respectively) A significant rise in the gamma globulin fraction to 0.75 ± 0.03 g% $P=1.3$ and 0.78 ± 0.02 g%, $P=0.1$ was noticed by the 10th and 15th days in minks inoculated only against distemper Throughout the course of these investigations, the changes in gamma globulin levels in the blood serum of minks vaccinated against botulism were statistically insignificant ($P > 5$) The content of albumins in minks of the first and third groups gradually fell within 15 days after vaccination (to 3.33 ± 0.06 g%)

Experiments to determine the formation of specific antibodies after complex immunization of minks showed that they were similar to those in animals given the vaccines separately

Among minks of the first and second groups, the formation of botulinic antitoxin in the blood serum was seen 21 days after vaccination, their titers being 0.002 ± 0.026 IU and 0.058 ± 0.029 IU There was then an increase in the antitoxin to 0.29 ± 0.001 IU and 0.32 ± 0.06 IU which remained at this level for four months Six months later, the antitoxin level dropped to 0.12 ± 0.04 IU in minks of the first group and to 0.16 ± 0.06 IU in minks of the second group Thus, the formation of botulinic antitoxin in the blood serum of minks inoculated simultaneously against botulism and canine distemper shows a negligible lag in antitoxin formation compared with the animals vaccinated against botulism alone

A study of the formation of antibodies to neutralize the canine distemper virus showed that the antibodies were formed 15 days after vaccination in minks given the combined vaccine against both these diseases, as well as in minks immunized only against canine distemper

This study also found that, before vaccination, antibodies were in the titers 1.5 ± 1.16 and 1.8 ± 3.25 in the first and third groups of minks Five and ten days after vaccination, the virus neutralizing antibodies were not found The formation of antibodies in the blood of the first and third groups of minks was noticed 15 days after vaccination The titer was 1.9 ± 3.36 and 1.16 ± 8.01 One month after immunization, the number of antibodies rose in the first and third groups to 1.250 ± 31.14 and 1.250 ± 51.37 After six months the antibodies neutralizing the distemper virus decreased to 1.160 ± 23.39 and 1.160 ± 40.09 in minks of the first and third groups In the unvaccinated minks of the fourth group, the virus neutralizing antibodies were seen without vaccination (1.5 ± 1.34)

Thus, the results of these investigations showed that the changes occurring in the blood of minks vaccinated simultaneously against botulism and canine distemper reflected the immunological reorganization of the organism

SIMULTANEOUS VACCINATION OF MINKS AGAINST BOTULISM AND CANINE DISTEMPER ON FUR FARMS

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With the recent formation of large fur farms and their operation as industrial bases, the use of specific prophylactic measures has acquired special significance

One of the rational methods of active prophylaxis against infectious diseases is the simultaneous (combined) vaccination of animals using available biological preparations

Investigations were carried out to develop a method for the simultaneous vaccination of minks against botulism and canine distemper. In the experiments 120 mink kits of standard color (half 45 days old and half 60 days old) were used. The test animals of each age group were divided up into five groups of 12 each.

The minks of the first group were vaccinated simultaneously with a single immunizing dose against botulism and two doses against canine distemper. The minks of the second group were given similar vaccinations in doses recommended by the supplier. Minks of the third and fourth groups were inoculated only with single vaccines against botulism and distemper. The animals of the fifth group were not vaccinated. The vaccine against botulism of minks and the virus vaccine of the attenuated strain 668-KF against distemper were used for the inoculations. Simultaneous vaccination was by intramuscular administration of each vaccine on the inner side of the thighs to the left and right of the pelvic limbs.

The postvaccination reactions were evaluated from the intensities of the resultant local and general reactions of the organism, daily clinical observations of the animals, and hematological and biochemical indices of the blood.

The immunity level of the minks was determined from the changes in the formation of specific antibodies 5, 10, 15, 21 days and 1, 2, 4 and 6 months after vaccination and by direct infection with botulinic toxin and distemper virus.

The results of investigations showed no intensification of the postvaccination reaction in minks on simultaneous vaccination against botulism and canine distemper. The reaction which took place was mainly determined by the more reactive of the vaccines, which in this case was the botulinic vaccine. On simultaneous administration of the biological preparations, the reactivities were somewhat lessened.

Studies of peripheral blood indices established that the hemograms of minks vaccinated simultaneously against botulism and canine distemper and of minks immunized against each infection individually did not differ significantly. Quantitative changes in hemoglobin, erythrocytes, and leukocytes occurred as in animals given single vaccines.

Refractometric and electrophoretic investigations of the blood serum of immunized minks revealed systematic changes in total protein and protein fractions in the blood serum. Studies of their dynamics in minks simultaneously vaccinated against botulism and distemper revealed protein spectrum changes similar to those in animals immunized against each infection individually.

Serological investigations established that in minks vaccinated simultaneously against botulism and distemper on the 45th and 60th days, botulinic antitoxin and virus neutralizing distemper antibodies were formed 15 to 21 days after vaccination. During their formation or prolonged presence in the blood serum, the variations were insignificant compared with the corresponding indices in minks inoculated by a single vaccine. A study of the dynamics of specific antibodies shows that it is possible to simultaneously vaccinate against botulism and distemper, and also that such a method of immunization does not hinder the formation of immunity against both these infections.

Determinations of the intensity of immunity established that minks given simultaneous vaccinations at the age of 45-60 days against botulism and canine distemper acquired 100% resistance to experimental infection by botulinic toxin type C and distemper virus for six months after inoculation (period of observation).

The method of simultaneous vaccination of minks against botulism and canine distemper was tested on 22,800 minks under field conditions.

SEROLOGICAL AND PATHOMORPHOLOGICAL DIAGNOSIS OF TOXOPLASMOSIS IN BLUE FOXES AND MINKS

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This paper presents the results of serological and pathological investigations of experimental toxoplasmosis

The complement fixation test (RSK) was carried out by Fulton and Dambell's micromodified method and microprecipitation in agar (MPA) by Hübner and Uhlikova's method (1973)

In the experiments 14 blue foxes were used, of which 12 (including six gestating females) were infected intramuscularly with the peritoneal exudate of white mice which contained 12 million *Toxoplasma* of RH strain, two blue foxes were left as controls. Three to four days after infection, sluggishness, loss of appetite, serous rhinitis, and conjunctivitis were noticed in the blue foxes, but there were no fatalities

The complement fixative antibodies with toxoplasmic antigen were detected in blue foxes on the 13th day after infection (first investigation) in the 1:32 and 1:256 titers. Toward the end of the first month, they rose to 1:128 and 1:512, and by the end of the third month they had dropped to 1:8 and 1:32, and remained at that level for seven months. After nine months, in all of the infected blue foxes, the results of RSK were negative

A positive MPA reaction was obtained 1, 2 and 3 months after infection, it became negative after 5 and 7 months. The positive reaction corresponded to a high RSK titer

The control blue foxes at that time recorded negative results for both reactions

Serological investigations of 106 female blue foxes with unfavorable whelping (at the experimental farm of the NIIPZK) revealed six females that had a positive MPA reaction (> 8%)

Pathological investigations were also carried out. Histological studies were made on 59 minks and 10 blue foxes experimentally infected with toxoplasmosis by different methods. These established that the clinical symptoms of toxoplasmosis can be detected earlier with subcutaneous infection than with oral infection. Gestating female minks and blue foxes infected subcutaneously and intramuscularly suffered, did not produce offspring, and experienced fetal resorption in the uterine horns. Pathological changes due to different methods of causing infection set in quite early, three to six days after the time of infection. A characteristic feature of toxoplasmosis is inflam-

matory and proliferative granulomatous changes in visceral organs with subsequent necrosis at the site of the granule. Changes are initially seen in the liver, lymph nodules, kidneys, and lungs, later, with the general spreading of pathological changes, these extend to the heart and brain.

Infected females gave birth to sick kits, which died shortly or were destroyed by the female herself. Histological investigations showed they had interstitial pneumonia, plasmocellular proliferates in the visceral organs, serous edema and circumcellular infiltration of pia mater, diapedesis in the brain and pericellular edema of neuroglia with lysis of the nuclei.

The micromethods of RSK and MPA may be recommended for large scale investigations of animals. They are simple to use, without requiring any special equipment and at the same time they give the required sensitivity. The results of pathological investigations may be used for postmortem diagnosis of toxoplasmosis in blue foxes and minks.

CLINICAL SIGNS OF ALEUTIAN DISEASE IN MINK

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Aleutian disease (AB) in minks is a chronic viral disease with a slow course. The most characteristic clinical symptoms of this disease are a reduction in fatness, thirst, hemorrhage, "black feces", paresis of the pelvis and more rarely of the thoracic extremities, and deformation of the neck (G K Hartsough and J R Gorham, 1956, G Trautwein, 1962 and 1964, and C F Helmboldt and E L Jungherr, 1958).

Among the latent, but characteristic, symptoms of the disease is hypergammaglobulinemia with a simultaneous reduction in albumin (J B Henson, M S Gorham, and R W Lieder, 1962, and J B Henson, 1961).

According to the work of J B Henson, R W Lieder, J R Gorham and J A Padgett (1966) and J B Henson (1961), once it starts, hypergammaglobulinemia steadily progresses and the animal dies.

There are also characteristic features of the course and manifestation of the disease, which the author could identify only after prolonged observations of the same animals. Mention should first be made of the so called "black feces" which has been referred to by several investigators. According to the author's observations, this is far from being a regular symptom. Very often, the feces of a sick animal is no different from that of a healthy animal. "Black feces" is possible in animals suffering from intestinal or gastric hemorrhage.

In the investigations carried out in autumn, the author frequently noticed that some young minks gave a positive but weak (one or two plus) Mallen's reaction (iodine agglutination test, IAP). These animals had high (up to 16-20-25%) and rarely normal amounts of gamma-globulin. Some minks with a normal content of gamma globulin had a high level of beta-globulin (up to 25-30% or more), this evidently was responsible for the positive reaction. Some of the animals with a positive reaction did not differ from the healthy minks for a long time, while others showed only a slight reduction in fatness, signs of thirst or both. These symptoms were transitory but could recur. In subsequent investigations, some animals maintained the positive reaction and a high level of gamma-globulin, while in others the IAP became negative but gamma-globulin was maintained at a high level (16-25) from year to year, in still others, the IAP became negative, but the gamma-globulin level did not go above 15%.

Initially, while studying the AB, the author could not explain these

changes R J Kirk (1967), too, noticed these, but could find no explanation

Based on recent observations of such animals, the author is inclined to believe that these symptoms are not accidental. Probably the organism, through some protective factors, normalizes the process of hypergamma globulinemia which has set in. As a result, further production of gamma globulin ceases and the overall state of the animal improves, but its level remains almost unchanged. Minks with a constant gamma globulin level of 16–25% or even 40–45% could survive for two to three years or more. Pathological data and investigations on the morphology and anatomy of the dead bodies of such animals revealed the presence of AB in them.

As a rule, minks suffering from AB develop paresis of the pelvic extremities. Paresis of the thoracic extremities is rare. The author observed, in fact, one case in which there was spontaneous restoration of the function of the thoracic extremities in a mink suffering from AB, due to paresis of the thoracic extremities, for several days it 'moved' on its shoulder joints dragging both fore limbs.

COMPARATIVE INDICES OF THE IODINE TEST AND ELECTROPHORESIS IN ALEUTIAN DISEASE

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The most widely used method for intravital diagnosis of Aleutian disease (AB) is the iodine agglutination test (IAP). In principle, this test is based on the ability of a solution containing a suitable proportion of iodine and potassium iodine to precipitate gamma-globulin, if its content in the blood serum exceeds the physiological level (12-15%). Since AB is accompanied by hypergammaglobulinemia, this simple and easy-to-use method is irreplaceable under field conditions in spite of its nonspecificity (J B Henson, M S Gorham, and R W Lieder, 1962, R J Kirk, 1967 and many others). The author fully supports this view.

However, having been engaged in the study of AB, and having used extensively IAP and paper electrophoresis for a decade, the author noted the fact that some minks with a high content of gamma globulin in the blood serum give a negative IAP. Such animals are found in a group every year and many of them give the same values from year to year. The number of such animals varies in different years, but it tends to increase in groups which have been exposed to AB for many years. This probably depends on the enzootic history of AB.

Thus, in 1969, when the author first studied the offspring from a group of minks especially chosen for the study of AB, 3.4% of the adults (58 in all) and 4.2% of the kits (142 in all) gave a negative IAP, but had a high gamma-globulin content in the blood serum. Its average was 16.6% among adults and 17.9% among kits. Minks in which it exceeded 15.5% were regarded as having a high gamma globulin level.

In 1970, 27.3% of the adult minks (190 in all) showed a negative IAP but a high content of gamma globulin, the corresponding percentage among juveniles was 14.7% (294 in all). The average gamma globulin level was 21.5% among adult minks and 18.0% among juveniles, while the gamma-globulin level in all the adult minks giving a negative reaction reached 13.6 ± 1.866 and in the juveniles 12.4%.

The autopsy of dead bodies and morphological and anatomical pathological investigations of the organs of minks with a negative IAP, but a high gamma globulin level confirmed the presence of AB in them.

J Greenfield, R Walten, and K R Macdonald (1973), by comparing

the results of nonspecific IAP with the results obtained by electrophoresis in a gel (RP), established that the latter was positive in 70% of the cases, while IAP was positive in only 54% of the cases. The gamma-globulin level among minks with positive RP exceeded 15%.

J. Ocetkiewicz, Jan Wiśniewski and Wajtocha Henryk (1972) established that an increase in the gamma globulin level occurs in 13.2% of the minks with a negative IAP. According to their results 90% of the time the level of gamma globulin is accompanied by changes typical of AB.

The fact that IAP does not identify some of the animals with a high gamma globulin level can perhaps be explained by the fact that, during AB, the protein composition of the blood undergoes not only a quantitative but also a qualitative change. It is possible that this is one way to protect the organism from the destructive consequences of the disease.

COMPARATIVE INDICES OF THE IODINE TEST AND ELECTROPHORESIS IN ALEUTIAN DISEASE

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Table 2. Mean level of gamma-globulin in minks with negative and positive IAP before and after the estrous cycle, percent

Year	Negative IAP	Positive IAP (as a whole)	According to the degree of intensity of IAP			
			1+	2+	3+	4+
Females before estrous cycle						
1969	9.8	31.0	20.3	25.7	26.1	44.5
1970	9.8	25.4	19.7	22.1	34.0	37.0
1971	9.5	27.0	21.7	25.0	28.0	40.0
1973	11.5	27.7	18.7	26.6	29.0	42.6
Females after estrous cycle						
1969	11.0	22.4	17.5	23.5	32.4	—
1970	13.4	27.4	20.6	24.0	36.8	44.0
1971	11.5	23.6	19.0	25.0	35.0	37.0
1973	14.7	29.6	23.0	26.0	36.3	45.5
Males before estrous cycle						
1969	11.7	17.0	17.0	—	—	—
1970	11.6	21.5	18.3	21.0	23.7	—
1971	10.6	26.2	21.1	26.2	—	38.3
1973	12.1	28.9	21.1	27.2	34.8	37.4
Males after estrous cycle						
1969	12.0	22.2	18.0	22.5	31.3	—
1970	11.6	21.5	17.4	21.8	30.6	—
1971	10.4	25.0	17.7	23.8	33.8	42.7
1973	14.7	27.6	22.3	27.2	33.8	41.1

EFFECT OF THE ESTROUS CYCLE ON THE SPREAD OF ALEUTIAN DISEASE IN MINKS

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Because of contact during the estrous cycle, this period is usually believed to provide for the most favorable conditions for the spread of Aleutian disease among minks. The author's data show a significant increase in sick minks after heat.

Thus, in 1969, the number of minks giving a positive iodine test (IAP) before heat was 15.5%, this rose to 23% after heat. In 1970, before heat, 19% of the females and 24% of the males gave a positive IAP, the corresponding values after the estrous cycle were 31 and 43%. In 1971, the number of females with a positive IAP before heat was 9.9% and of males 8.0%, after heat these figures rose to 30 and 32.5%, respectively. In 1973, before heat, 15% of the females and 19% of the males showed a positive IAP, after heat this rose to 28.5 and 33%, respectively. The degree of IAP manifestation ranged from 1 to 4 pulses (Table 1).

Table 1. Percentage of minks with positive IAP before and after the estrous cycle

Year	Before estrous cycle				After estrous cycle			
	1+	2+	3+	4+	1+	2+	3+	4+
Females								
1969	28.6	14.3	14.3	42.8	50.0	30.0	20.0	—
1970	30.0	41.0	17.3	11.7	44.0	32.2	8.8	15.0
1971	23.5	35.0	29.5	12.0	56.2	20.0	16.4	7.4
1973	18.5	26.0	52.0	3.5	39.0	22.5	20.5	18.0
Males								
1969	100.0	—	—	—	50.0	33.0	17.0	—
1970	40.0	30.0	30.0	—	53.0	29.6	17.4	—
1971	29.0	57.0	—	14.0	42.0	27.0	23.0	8.0
1973	20.0	10.0	60.0	10.0	44.0	12.5	37.5	6.0

It is difficult to pinpoint exactly what caused this increase in minks with a positive IAP after the estrous cycle. Could it be the result of excessive infection or the influence of additional stress states? Probably both of these factors are responsible.

Table 2 Protein composition of the blood serum in adult minks in different seasons

No of tests	Index	Winter (February)	Summer (June July)	Autumn (Sept Nov)
Standard				
21	Total protein	9 15±0 19	8 1±0 12	—
	Albumin	56 3±1 7	51 8±1 1	54 1±1 4
	Globulins			
	alpha	13 8±1 2	13 9±0 45	16 2±0 86
	beta	20 6±1 2	22 2±0 9	19 0±0 95
	gamma	9 6±0 6	12 0±0 5	10 7±0 34
Standard (S vedish)				
5	Total protein	9 08±0 63	8 22±0 33	—
	Albumin	54 4±0 3	51 4±1 7	53 6±3 6
	Globulins			
	alpha	14 9±0 9	13 3±0 6	17 1±2 57
	beta	21 2±2 1	21 1±1 9	18 5±2 3
	gamma	9 6±1 2	14 2±1 2	10 9±0 6
Palomino				
7	Total protein	9 54±0 26	8 35±0 18	—
	Albumin	57 0±1 7	52 1±2 0	52 7±1 27
	Globulins			
	alpha	11 9±0 6	14 2±1 0	16.9±1 0
	beta	21 8±2 2	22 9±1 2	19 6±1 05
	gamma	10 1±1 2	10 6±0 8	10 9±0 35

The data given in Table 2 shows that the highest albumin indices occur in winter and the lowest in summer. In autumn, the alpha globulin content, rises, while the beta globulin level decreases slightly.

SERUM PROTEIN COMPOSITION IN ADULT MINKS

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The protein composition of blood serum reflects the overall status of an organism and quite often points to the prevailing pathological condition

Along with pathological changes, some physiological changes associated with age, sex, season, etc , also take place

We analyzed the serum protein composition of the blood in relation to the color of the minks, their sex, age and season (Table 1)

Table 1 Serum protein composition in minks (males and females) of different colors

No of tests	Sex	Total protein	Albumin	Alpha globulin	Beta globulin	Gamma globulin
Standard						
34	Female	8.8 ± 1.09	55.6 ± 1.064	14.6 ± 0.656	14.8 ± 0.453	15.0 ± 0.596
8	Male	10.1 ± 0.379	53.0 ± 2.343	14.3 ± 1.435	18.2 ± 2.567	14.5 ± 1.58
Standard (Swedish)						
34	Female	8.73 ± 0.338	55.7 ± 0.95	15.7 ± 1.431	13.7 ± 0.38	14.9 ± 0.554
8	Male	8.94 ± 0.36	53.6 ± 1.48	14.2 ± 1.063	16.1 ± 0.713	16.1 ± 1.0
Palomino						
37	Female	8.6 ± 0.09	55.8 ± 0.99	13.7 ± 0.578	15.0 ± 0.466	15.0 ± 0.663
13	Male	9.43 ± 0.287	53.8 ± 1.399	15.5 ± 0.689	15.8 ± 1.5	14.9 ± 0.676

The data given in Table 1 shows that the serum protein composition in minks is not related to the color of the animals, but there are differences between the sexes. The total protein and beta globulin levels are higher in males of all colors, and the albumin is higher in females. The alpha- and gamma globulins varied at random.

Similar changes in relation to sex were noticed even then following year in all except palomino minks. In these the albumin content was no higher in females, but in males the alpha- and beta globulins were higher in males than in females.

Seasonal variations in the protein composition have also been recorded (Table 2). These are particularly noticeable when the investigations are carried out on the same animals.

Table 1 Protein composition of the blood serum in young minks in relation to color and sex

Color	Sex	No of animals	Total protein	Albumin	Globulins		
					alpha	beta	gamma
Standard	Male	50	7.14±0.093	56.7±1.128	14.7±0.697	17.7±0.594	10.9±0.632
	Female	50	7.26±0.153	53.6±1.015	14.1±0.605	20.0±0.763	12.1±0.647
Falmiano	Male	50	7.16±0.107	50.0±1.147	16.0±0.642	20.9±0.859	13.1±0.545
	Female	50	7.22±0.106	50.8±0.971	15.7±0.659	21.2±0.779	12.3±0.368
Svedish (standard)	Male	50	7.03±0.173	52.0±0.882	14.7±0.606	22.0±0.706	10.9±1.109
	Female	50	6.91±0.163	51.4±1.053	16.8±0.762	20.5±0.913	11.2±0.681

SERUM PROTEIN COMPOSITION IN MINK KITTENS

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Many investigators have studied the protein composition of blood serum in minks including juveniles. It has been established that, by six to seven months of age, the protein composition of the blood serum in kits corresponds to that in adult minks (Berestov, 1971). According to the data given by E S Romanov (1966, cited by V A Berestov), it comprises total protein 8.12 g%, albumin 58.8, alpha globulin 17.2, beta globulin 18.5, and gamma globulin 5.5%. According to A M Yudin, the values for males and females respectively are albumin 42.3 and 42.1%, alpha globulin 14.9 and 21.0%, beta-globulin 26.8 and 20.7%, and gamma globulin 16.0 and 16.2%.

Our data are given in Table 1 (kits aged six to seven months were investigated). These data point to slight differences in the protein composition of the blood serum in minks in relation to color and sex, but then only in albumin content. Thus the albumin content was lower in palomino minks (males and females), than in standard minks, especially males. In standard and Swedish (standard) mink kits, unlike in adult minks, the albumin level was high in the males. Moreover, it was the same in all palomino minks. The total protein level was almost the same in all minks at 7.0-7.3%.

The content of the other fractions varied. In minks of one color group, the variations were greater in males, while in another color group they were greater in females. But the absolute values were approximately the same in all of the color groups. These differences are perhaps transient.

and filled with enough sterile physiological salt solution to simulate the original serum dilution of 1:5. The test tube was placed in a thermostat at 37°C for 1–2 hr (or for 5–6 hr in a refrigerator at 4–6°C). Later it was centrifuged for 7–10 min at 1,000 r.p.m., and sucked out. The serum was inactivated on a water bath at 56°C and later used for RSK and RFSK tests (fluorescent complement fixation reactions).

The dry serums of 58 minks and 40 blue foxes were studied simultaneously by the above method for their serological reactions. The infection of minks based on RSK was 13.8% and according to RFSK 20.7%. A positive RSK was recorded in 7.8% of the blue foxes, while according to the RFSK 15.0% of the serums were positive.

The above results of the dry serum tests show no more deviations than our earlier data for the native serums of these same species.

In all cases, when the study of native serums is difficult, the "dry drops" method should be adopted for serological investigations of toxoplasmosis.

USE OF "DRY DROPS" IN SEROLOGICAL INVESTIGATIONS OF TOXOPLASMOSIS IN FUR-BEARING ANIMALS

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Serological investigations are of major importance in diagnosing toxoplasmosis in animals. The absence of well-equipped serological laboratories on fur farms renders such studies difficult at site. At the same time, despatching the blood samples to specialized laboratories is also difficult, because of the rapid onset of the hemolysis of erythrocytes.

In the present work, we attempted to study the possibility of using the "dry drops" method in serological investigations for toxoplasmosis in fur-bearing animals.

The primary task was to ascertain whether there was any difference in the results of serological tests carried out simultaneously on native and dry serum obtained from healthy animals and those with toxoplasmosis.

The studies covered the serum of 49 healthy rabbits and 40 healthy pigs, and the serum of 57 rabbits and 32 pigs seropositive to toxoplasmosis.

The "dry drops" were prepared by drying 0.1 to 0.5 ml fresh serum on sterile plain paper at room temperature. The "dry drops" prepared from each seropositive serum were placed on three papers. After preservation at room temperature, these were studied for their serological reactions (complement fixation test, RSK, and alexin fixation test, RFA), first after 3-4 days, then after 5-6 days, and again after 7-11 days.

The native serums were studied simultaneously for RSK and RFA in the first few days. All of the seronegative serums of pigs and rabbits gave negative results, when tested in their native state as well as in the form of "dry drops".

When studying the RSK and RFA positive serums by the "dry drops" method, it was noticed that the dried serums preserved their activity for three to six days when stored at room temperature. On highly prolonged storage, the antibody titers fell significantly. We, therefore, feel that dry serums should be studied no later than six days after the day of preparing the sample. The stable and concordant results obtained with dry and native serums have encouraged us to test the "dry drops" method in fur-bearing animals.

The serums prepared in the form of dry drops directly on the fur farm were packed and sent to the departmental microbiology laboratory within three to five days. In that laboratory, the paper with the dried serum (volume 0.1 to 0.5 ml) was stripped, ground, placed in the test tube of a centrifuge

± 3.5), 154 coypus (33.1 ± 3.7) and 739 rabbits (25.98 ± 1.6). The antibody titers ranged from 1:5 to 1:320. An avirulent strain of *Toxoplasma* was isolated from rabbits whose serum reacted positively at 1:320 (three crosses). The RSK was used to study the serum of 74 experimentally infected rabbits.

In the blood of 33 rabbits infected intraperitoneally with an avirulent strain of *Toxoplasma*, antibodies were seen on the seventh day in the 1:5 titer, by the end of the second week, the titer went up to 1:40–1:80, and by 1–1.5 months it was 1:80 to 1:360. It remained at that level, with only a slight decrease, for three years (period of observation). Among the rabbits infected subsequently, antibodies formed somewhat later and reached the maximum titers of 1:640 to 1:1280 by the second to the sixth month.

In the blood of 41 rabbits infected with virulent strains of *Toxoplasma*, the antibodies were also seen on the seventh day. They increased rapidly by 1–1.5 months, and later behaved in the same way as in the preceding study.

Spontaneous infection with *Toxoplasma* was tested by RSF, RNG, and RIF in 178 rabbits whose blood serums were studied in different combinations. RSK and RSF were used to study 115 animals, the agreement between the positive and negative results was 90.43%. RSK and RNG were used to study 61 animals and the agreement between results was 85.25%. RSK and RIF were used to study 74 animals, among these 13% were positive to RSK and 20.27% to RIF.

These four tests were all used to study the serum of 32 animals. The number of positive results was 2 (6.25%), 4 (12.5%), 4 (12.5%), and 1 (3.12%).

Our data show that all four serological reactions are sensitive and specific for studying the blood serum of farm-bred fur-bearing animals and rabbits. Their sensitivity may be judged in the following order: RSF, RIF, RSK, and RNG. For practical purposes, the most suitable is the RSK, using antigens from *Toxoplasma* isolated from animals.

SEROLOGICAL DIAGNOSIS OF TOXOPLASMOSIS IN FARM-BRED FUR-BEARING ANIMALS AND RABBITS

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The diagnostic importance of the complement fixation test (RSK), immunofluorescence reaction (RIF), globulin neutralization reaction (RNG) and flocculation reaction (RSF) was studied in relation to toxoplasmosis in the blood serum of spontaneously and experimentally infected farm-bred, fur-bearing animals and rabbits. The work was carried out from 1957 up to 1973 in the Toxoplasmosis Laboratory of the Institute of Zoology, Academy of Sciences, Kazakh Soviet Socialist Republic. It was thought that the serums of adult silver-black foxes, minks, coypus, and rabbits had intense anticomplementary properties. Hence, in carrying out the RSK, titration of the complement was done in the presence of an antigen and a normal serum of the same species which had been investigated before. For the main test the addition of complement was permitted up to 50% while studying the serum of adult animals, and 25-30% in the case of juveniles. Correspondingly, serum inactivation was carried out at temperatures of 60-65° and 56-60°C. The prolonged fixation method was used (in a refrigerator at +4°C) as it was thought to be more sensitive than the usual method carried out at a temperature of +37°C. In order to test the sensitivity of the different methods, 222 samples of serum obtained mostly from experimentally and spontaneously infected animals were studied. The prolonged method gave a greater number of positive results (52.7 + 3.3%) than the method of fixation in a thermostat (35 + 3.2%).

The most difficult stage in the RSK is the preparation of a good quality antigen. For studying the serum of fur-bearing animals, the antigens recommended are those made from *Toxoplasma* isolated from animals (preferably from fur-bearing animals). To test the sensitivity of the antigen prepared by us using the laboratory method (from strains isolated from the animals), we carried out several parallel investigations with antigens (from the RH strain isolated from human beings) prepared by the commercial method in the Gamalei Institute of Epidemiology and Microbiology and in the Mechnikov Institute of Vaccines and Epidemiology, Odessa (240 and 51 serums obtained from infected animals). The percentage of agreement between the positive and negative results was 82.0 and 82.3. The RSK test was used as follows for spontaneously infected animals: 2,496 silver black foxes of which 29.3 ± 0.9% reacted positively, 405 blue foxes (16.8 ± 1.8), 176 minks (32.3

In order to prevent these diseases in cubs reared in concrete cages, the animals should be given dry bedding in autumn, winter, and spring. It should be changed every 3 or 4 days. Special attention should be paid to the regular cleaning of the cages and their disinfection.

SOME DISEASES OF YOUNG COYPUS REARED ON FARMS

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Work was carried out on the Karayazsk state fur farm in the Azerbaijan Soviet Socialist Republic. The coypus there were reared in concrete cells and pens.

In 1974 and 1975 (25 days in each season), for a total of 200 days, over 6,200 bodies of dead coypus were dissected. Of these 5,100 were juveniles aged one to three months and 1,100 were adults.

Pathological investigations showed that the cause of death in juvenile coypus was mainly purulent inflammation of the lungs or purulent maxillary sinusitis. Among the juveniles autopsied, 32.1% were found to suffer from purulent inflammation of the lungs and 16.0% from purulent maxillary sinusitis. In 16.4% of the cases, the animals suffered from both of these diseases. In general, 64.5% of all deaths were attributed to these diseases.

Of the total number of coypu cubs that had died from purulent inflammation of the lungs or purulent maxillary sinusitis, 3.2% had been kept in pens and 96.8% in concrete cells.

With purulent inflammation, there were innumerable gangrenous foci localized in the dorsal ventral sections of both lungs. Usually the pulmonary gangrene was diffuse. In such cases, along with damage to the pulmonary tissues, purulent inflammation of the bronchi was also noticed. Quite often, purulent-putrefactive pleurisy was also present. In animals affected by purulent maxillary sinusitis, all of the maxillary sinuses and often the frontal cavities were filled with a purulent mass.

In animals with purulent inflammation of the lungs or purulent maxillary sinusitis, the hair coat lacked luster and a purulent-putrefactive flow excreted liberally from the nasal cavity.

The incidence of purulent inflammation of the lungs and purulent maxillary sinusitis varied sharply from season to season in coypu cubs. In summer, when the atmospheric temperature was quite high, the number of sick cubs was minimal at 2.2% of all registered cases. In autumn, the number of the sick increased (13.7%). A high incidence was noticed in the winter (40.0%) and spring (44.1%).

In our opinion, the etiological factors in the present case were the long duration of exposure to cold of the still-weak coypu cubs kept in concrete cages, and also their poor veterinary sanitary conditions.

71.7%, respectively. The dose of 10^{10} TTsD₅₀ did not produce statistically significant variations in total protein or its fractions with either method of vaccination.

On the 15th day after controlled infection, there was a reduction in the albumins and an increase in the total protein and gamma- and alpha globulin fractions. By the 30th day, the amount of gamma globulin remained high, while the content of alpha-globulin dropped to its original level. In the control tkhorzofretkas vaccinated with a dose of 10^{10} TTsD₅₀, there was a sharp reduction in total proteins, albumins and gamma globulins, and an increase in the percentage of alpha- and beta-globulins.

The increase in the gamma-globulin fraction in the blood serum of tkhorzofretkas after vaccination by the "EPM" strain of VChP was correlatable with the accumulation of virus neutralizing antibodies.

Immunization brought about a reduction in the albumin globulin coefficient.

Thus, vaccination of these animals with the "EPM" strain of VChP was accompanied by a change in the total protein and protein fraction levels in the blood serum. Aerosol vaccination with the "EPM" strain brought about a sharper increase in gamma-globulins in the first few days after vaccination.

SERUM PROTEIN LEVELS IN TKHORZOFRETKAS IMMUNIZED AGAINST CANINE DISTEMPER

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Changes in the blood serum proteins during the post-vaccination period serve as an important index of the response of the organism to the administered antigens

We studied the variations in total protein and protein fractions in the blood serum of tkhorzofretkas in relation to the dose and method of administration of the "EPM" strain of vaccine of the canine distemper virus (VChP). The experiment covered 48 tkhorzofretkas of which 20 (five groups of four each) were vaccinated subcutaneously with a dose of 10 to 10^5 TTsD₆₀, 16 (four groups of four each) were vaccinated by aerosol with a dose of 10 to 10^3 TTsD₆₀, and 12 were not vaccinated to serve as controls. The intensity of immunity was tested by controlled infection with a virulent VChP strain on the 21st day after vaccination. The blood for the serum was drawn from the tail before the experiment, 7, 14, and 21 days after vaccination, and on the 15th and 30th days after infection. Total protein was determined by refractometer, protein fractions by paper electrophoresis. The results obtained after vaccination were compared with the original data and the results obtained after infection with the data obtained before the control of the infection.

Aerosol and subcutaneous vaccination with the "EPM" strain of VChP resulted in the same type of changes in blood serum protein ratios. A general pattern noticed in the test animals was the increase in total protein and gamma globulin, and the decrease in albumin after vaccination. Alpha- and beta globulins showed no significant changes.

An increase in gamma-globulin was seen in the subcutaneously vaccinated animals on the 7th day after vaccination (by 10–23.2%). This continued up to the 14th to the 21st day. The maximum increases, by 45 and 54.3%, were seen on the 21st day after vaccination in animals subcutaneously vaccinated with doses of 10^4 TTsD₆₀ or 10^5 TTsD₆₀. In animals vaccinated with doses of 10^3 TTsD₆₀ and 10^2 TTsD₆₀, the gamma globulin, after rising by 44 and 31.6%, respectively, by the 14th day, dropped by the 21st day.

In the group of animals vaccinated by aerosol, with doses of 100, 300 and 1,000 TTsD₆₀, the gamma globulin level rose by 23.5%, 26.2% and 41.4% on the seventh day, and by 26.5, 32.7 and 63.6% on the 14th day. Before infection, compared with the initial value, this increase was 5.9, 15.0 and

Table 2. Variations in the differential blood counts of thhorzofretkas with age

Age	No of animals	B	E	Neutrophils			M	L
				Juvenile	Stab	Mature		
3 months	24	—	27±0.27	0.4±0.1	4.3±0.31	27.4±0.31	2.5±0.20	62.7±0.19
4 months	27	0.2±0.02	2.1±0.1	0.3±0.09	7.8±0.25	32.5±0.47	2.3±0.19	54.8±0.43
5 months	116	0.2±0.09	2.1±0.23	0.3±0.12	8.1±0.1	38.3±0.32	1.6±0.20	49.4±0.19
7 months	19	0.2±0.07	2.2±0.38	0.1±0.08	11.1±0.13	48.1±0.18	2.3±0.14	36.0±0.42
2 years	20	0.1±0.07	2.4±0.2	0.1±0.06	12.4±0.27	51.2±0.29	1.5±0.11	32.3±0.55

SOME MORPHOLOGICAL AND BIOCHEMICAL INDICES OF NORMAL BLOOD IN TKHORZOFRETKAS

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Hematological investigations and the study of serum proteins continue to be of importance when studying the physiological state, age, and the course of pathological and post vaccination processes in an organism.

This paper gives data on the content of hemoglobin, the erythrocyte count, and differential blood count, as well as the content of total protein and its fractions in the blood serum of tkhorzofretkas in relation to age. When determining the contents of hemoglobin, erythrocytes, and leukocytes, well known methods have been used. The leukogram was developed after staining by Romanovski's method and counting 200 cells in a smear. The total protein was determined by refractometry and protein fractions by paper electrophoresis. The values obtained were subjected to statistical analysis (Asatiani, 1965). The results of the investigations are given in Tables 1, 2, and 3.

Table 1 Morphological indices of the blood of tkhorzofretkas

Age and sex of an animal	No. of animals	Hemoglobin g%	Erythrocytes (millions)	Leukocytes (thousands)
3 months	24	11.2 ± 0.11	7.24 ± 0.20	7.94 ± 0.27
Males	18	10.9 ± 0.13	7.30 ± 0.22	7.85 ± 0.23
Females	6	11.9 ± 0.11	7.18 ± 0.31	8.00 ± 0.30
4 months	27	13.3 ± 0.14	7.84 ± 0.22	6.90 ± 0.22
Males	14	13.0 ± 0.17	7.90 ± 0.24	7.12 ± 0.29
Females	13	13.5 ± 0.19	7.77 ± 0.23	6.80 ± 0.31
5 months	116	14.0 ± 0.1	8.51 ± 0.20	6.00 ± 0.12
Males	84	13.1 ± 0.1	8.64 ± 0.24	6.12 ± 0.14
Females	32	14.9 ± 0.12	8.37 ± 0.31	5.91 ± 0.17
7 months	19	15.1 ± 0.13	9.54 ± 0.29	5.40 ± 0.29
Males	14	14.7 ± 0.14	9.78 ± 0.38	5.01 ± 0.34
Females	5	15.6 ± 0.21	9.43 ± 0.39	5.91 ± 0.40
2 Years	20	16.8 ± 0.33	10.24 ± 0.26	5.36 ± 0.13
Males	4	16.0 ± 0.33	10.17 ± 0.40	5.08 ± 0.25
Females	16	17.2 ± 0.23	10.20 ± 0.28	5.76 ± 0.17

UROGENITAL DISEASES OF FEMALE BLUE AND SILVER BLACK FOXES

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Although a certain proportion of animals remain sterile every year on fur farms, the reasons for this phenomenon have not yet been adequately studied. In 1975 and 1976, therefore, 57 carcasses of female blue and silver black foxes which had remained sterile in these years were studied on the Vyatka fur farm. During pathological investigations of these carcasses, a large group of diseases affecting the genital organs was discovered.

Cystic damage to the ovaries was noticed most often. Morphologically this was manifested in the form of cavity formations in the ovaries. Some times, this process was so pronounced that the stroma of the ovaries nearly disappeared. Such alterations in the ovaries were seen in 22% (12 in number) of the sterile females. In the majority of such females, there were no early clinical symptoms of the disease and consequently neither curative nor stimulative treatment, apart from prophylactic inoculation, could be given.

A fairly common affliction of the reproductive organs is chronic endometritis. Among the 57 carcasses studied, changes were noticed in 11 cases, or 21% of the females under investigation. In the sick animals, the inner lining of the uterus became three to four times thicker. The connective tissue at the base also became extensively developed and dense. The uterus was significantly enlarged. On clinical examination, swelling of the loop, transparent or blood containing vaginal flow, and restlessness were noticed in the females. In some cases the appetite was poor. As a result, the females lost weight, but at the time of slaughtering, the sick animals were indistinguishable from their healthy counterparts (as regards their weight and fatness).

Parametritis or inflammation of the perimetrial cells is extremely close to endometritis. In the course of these investigations, changes were detected in three carcasses. The etiological factors responsible for inflammation of the tissues are difficult to establish. Probably this disease is a consequence of endometritis. At the time of slaughtering, the females did not have any clinical symptoms of the disease.

In eight cases, we noticed erosion and cicatricial adhesion of the uterine neck. Information available in literature shows that these changes arise as a consequence of labor difficulties. Thus, in the formation of a herd, the birth process will have to be taken into consideration. Any female with an abnormal delivery should be discarded.

Table 3 Protein composition of the blood serum in tkhorzofretkas

Age and no of animals	Total protein, %	Albumin, %	Globulins, percentage			A/G
			Alpha	Beta	Gamma	
3 months P=24	6.39±0.10	56.4±0.34	16.4±0.46	17.9±0.41	9.8±0.49	1.30±0.05
4 months P=27	7.05±0.15	59.3±0.41	14.4±0.32	16.0±0.36	10.2±0.31	1.46±0.04
5 months P=116	7.20±0.11	59.0±0.24	14.1±0.31	15.9±0.29	11.4±0.21	1.43±0.02
7 months P=19	7.49±0.11	58.8±0.47	13.7±0.34	14.8±0.32	14.2±0.36	1.42±0.02
2 years P=20	7.64±0.09	58.3±0.32	13.2±0.18	14.1±0.47	15.0±0.32	1.39±0.02

As can be seen from the above tables, the hematological indices, the amount of total serum protein and its fractions, vary in relation to the age of the animal. The variations occurring up to the seventh month of age are most pronounced. Females show very high indices of hemoglobin and leukocytes. The level of erythrocytes is lower in females than in males.

TESTING THE "EPM" STRAIN OF VACCINE AGAINST CANINE DISTEMPER ON SUSCEPTIBLE FUR FARMS

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Vaccines made from live attenuated distemper virus provide specific prophylaxis against canine distemper among fur-bearing animals and dogs. Antidistemper vaccines produced on different cellular cultures of animal tissues are used in practice for immunization.

The indigenous vaccine made from the "EPM" strain has undergone extensive testing on fur farms located in different climatic zones of the Soviet Union with positive results. For immunization of juvenile and adult silver-black and blue foxes, minks, and dogs, the vaccine is administered intramuscularly. This vaccine is innocuous and imparts high immunity to the animals.

The object of these investigations was a comparative testing of vaccines made from the "EPM" strain and the American ASL antidistemper vaccine. The tests were carried out on three fur farms where there were cases of enzootic distemper of minks and blue and silver-black foxes.

In the summer of 1975, on the Solntsevsk state fur farm, distemper broke out among juvenile silver-black foxes and minks. The "EPM" strain of vaccine was inoculated to 400 silver-black fox cubs and 45,277 mink kits. The American vaccine was given to 4,047 fox cubs. Before vaccination with "EPM", 40 silver-black fox cubs in the eleventh brigade of the fox farm had died. Two months after vaccination, the murrain decreased by half and ceased altogether within three months. In the remaining brigades, also, where ASL vaccine was used, the results were similar. On the mink farm where the "EPM" vaccine was used right from the start of the outbreak, distemper was arrested and only isolated fatalities were recorded.

In 1976 the "EPM" strain of vaccine was used as an emergency measure during an outbreak of distemper on the Vil'ki state fur farm (Lithuanian Soviet Socialist Republic). Before vaccination, in August, the epizootic condition was found in 1,605 mink kits. Therefore, 14,612 mink kits were inoculated with this vaccine as an urgent measure. Simultaneously, for purposes of comparison, 15,360 kits were inoculated with the American ASL vaccine. A month after the vaccinations, the incidence among juvenile minks fell sharply and ceased altogether by the time of the scheduled slaughtering.

In the uteri of three carcasses, tumor-like growths of tissue were noticed. In two cases, the tumors were the size of a pea, while in the uterus of the third, it was the size of a large egg. These formations were fairly dense and a section of the tissue revealed a light pink coloration. The structure of these growths resembled muscular tissue.

Thus, the results of anatomical investigations of the carcasses of sterile females showed in almost all of the animals, extremely important changes in the tissues of the genital organs. Evidently, these changes were responsible for sterility.

CONTROL OF VIRAL ENTERITIS VACCINE FOR MINKS USING DIFFUSION PRECIPITATION REACTION IN AGAR GEL

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The object of the present investigation is to study the possibility of preparing viral enteritis vaccine for minks using diffusion precipitation reaction (DPR) in agar gel (O. Ouchterlony's method). Such work has not been found in any earlier literature.

The DPR is an aggregation of viral antigen produced in the presence of specific antibodies. It is seen as precipitate bands in a layer of agar between alveoli containing the antigen and the specific antibodies. The viral particles may be precipitated in the immune serum, but for the formation of visible aggregations of these particles, their concentration must be high. Therefore, in carrying out the reaction, a suspension containing the highest amount of enteritis virus (10^6 $\text{IMD}_{50}/\text{ml}$) was used. This suspension served as an antigen for DPR and also for producing hyperimmune standard serums, and for preparing the vaccine. During viral enteritis of minks a visible precipitation band is formed when 1 ml of suspension contains not less than 10^7 $\text{IMD}_{50}/\text{ml}$ of the virus (unit of specific precipitogen in a reaction volume of 0.02 ml, maximum dilution of standard serum 1:64).

In order to study the correlation between the content of specific antigen in the vaccine and its immunogenicity, as well as its ability to cause the formation of precipitating antibodies in the animals, various vaccines with different levels of specific antigens were prepared.

The data obtained help us to conclude that the precipitating antibodies appear only in the blood serum of animals immunized by vaccine containing 10^6 IMD_{50} enteritis virus per ml before inactivation. The vaccines containing 10^5 IMD_{50} virus per ml before inactivation promote immunity in minks, but such a vaccine is not formed in sufficient quantity of precipitations to be collected with the aid of DPR in the immunized animals. The precipitating antibodies were also not detected in the blood serum of minks immunized by vaccine containing 10^4 IMD_{50} enteritis virus per ml before inactivation, but these animals became infected with enteritis after controlled infection by virulent virus.

Thus, the amount of enteritis virus in a vaccine can be controlled by using DPR. The quantum of precipitating antibodies in the vaccinated minks which can be collected with the aid of DPR suggests that before inactivation the vaccine should contain not less than 10^6 IMD_{50} enteritis virus per ml. This shows its good immunogenic qualities.

In early October 1976, the "EPM" strain of vaccine was used during the height of an epizootic distemper outbreak on the Kirovograd fur farm. In July, all of the juvenile minks on this farm had been systematically immunized by the "KF 668" strain of vaccine. The first instances of attack among the minks were reported a month after the vaccination. In spite of the vaccinations, the death of juvenile and adult minks rose steadily. In all, 420 minks, out of a population of 2,520, died of distemper. Hence, in early October, all of the minks (3,122) were revaccinated with the "EPM" strain of vaccine. A month after the revaccination, the incidence of the disease dropped by half and three months later the disease and the murrain among minks with clinical signs of distemper ceased altogether.

Thus, the use of vaccine made from the "EPM" strain on three fur farms susceptible to canine distemper gave positive results. The disease and murrain among minks and foxes ceased after administration of this vaccine by providing stable immunity to the animals.

PATHOGENICITY OF *CLOSTRIDIUM PERFRINGENS* TYPE "A", IN MINKS

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An analysis of the data available in literature on the role of *Clostridium perfringens* in the diseases of minks pointed to its role in the heavy mortality of juveniles (Litvinov and Grishin, 1965 and Danilov, 1967). However, the importance of anaerobes during the reproduction period of minks has remained vague so far.

To study this, 20 female minks in the latter half of gestation were experimentally infected with *Cl. perfringens* type "A". A culture of *Cl. perfringens* was rubbed into the pre-scarified mucous membrane of mouth or on the scarified skin daily. For two days thereafter, the animals were fed 0.5 ml of *Cl. perfringens* culture daily. It was also administered to the minks subcutaneously. A day later, the test minks showed a reduction or total lack of appetite. They could not stand on the feet which had been rubbed with the culture. Later, a generally depressed state, feed rejection, and progressive emaciation were noticed. One test mink died on the third day without whelping. Autopsy revealed edema of the subcutaneous tissue in the lower abdominal portion, a uterus with dissociated embryos, and hepatic and renal dystrophy. In another mink, at the site of administering the culture, a broad wound formed with a purulent greenish exudation. In yet another mink, resorption of embryos occurred.

Comparative data of whelping showed that the yield of kits from the test minks was 1.8 and 2.4 per female, while it was four kits from females in the control group.

Bacteriological investigations of 372 minks carcasses from different state fur farms revealed anaerobic micro-organisms in only four cases.

The most likely source of infection is feed infected with *Cl. perfringens*, especially the meat products of slaughtered animals. Thus, according to the data of R. I. Sidorenko and Yu. P. Pivovarov (1964), different types of *Cl. perfringens* were isolated in 46.8% of the killed sheep. In our investigations of fish feeds, whale meat, and mixed feeds (91 samples in all), *Cl. perfringens* could be isolated only from one sample of mixed feed.

These results showed that *Cl. perfringens* type "A" is pathogenic to gestating minks. Death of the embryos and newborn kits and serious illness in the adults were noticed among the test animals.

COMPLICATIONS OF ENCEPHALOPATHY IN MINKS CAUSED BY BACTERIA

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Encephalopathy is a little studied viral disease found in minks. According to the work of R. P. Hanson et al. (1971), minks contract this disease by consuming the tissues of sheep afflicted with bacterial infections.

We investigated over 300 minks which had died of encephalopathy and sick ones that had been killed. Typical clinical symptoms were noticed in the sick animals. As a rule, the sick minks were in an excited state, trampled their feed, bit their tails and rear feet, or the cage. Some even died from bitten tails and feet, or from biting the small bones present in the feed. Most often, the tails of sick minks were raised. The *status raptus* gave way to a state of depression, the animals rapidly worsened, swayed, and shivered. The fur became lackluster, dishevelled, and soiled with feed or fecal matter.

Anatomical changes were similar. Infection of the meningeal vessels was seen, and there were various levels of hepatic and renal dystrophy, as well as gastro-intestinal and pulmonary inflammatory changes.

Bacteriological investigations were carried out on 54 carcasses and 93 dead bodies of killed sick minks. *Bacillus coli* was present in 62.9% of the dead animals and *Proteus* in 9.2%. Both cultures were pathogenic to white mice. In spite of a high percentage (83.1%) of invasion of the dead bodies by *Diplococcus*, not a single case yielded a pathogenic culture. The investigations of killed sick minks revealed a somewhat different picture. Firstly, in 44% of the carcasses investigated, no micro-organism could be isolated. *Bacillus coli*, pathogenic to white mice, was noticed only in 9.6% of the cases. There was a high level of infection of the dead bodies by *Diplococcus*, 21% of them being pathogenic to white mice. Apart from *Bacillus coli* and *Diplococcus*, thermolabile gram-positive bacilli were isolated from the submucosa of the intestine in 43% of the carcasses. These bacilli were pathogenic to white mice. Anaerobic micro-organisms were not detected.

Simultaneous investigations of the feed mixture established its contamination with *Bacillus coli* pathogenic to white mice.

These investigations showed that the cultures isolated from minks with encephalopathy had secondary micro-organisms. Although septic processes often developed in the sick animals, the increased level of pathogenic bacterial strains is due to the low resistance of the minks as a result of the viral infection.

It is quite possible that the secondary infections promoted certain pathological changes in minks sick with encephalopathy.

using the microagglutination reaction, i.e., lysis of the blood samples of hares and foxes with different strains of *Leptospira*

Our data show that, in Byelorussia, hunted birds and fur-bearing animals provide the active media in the natural reservoirs of toxoplasmosis, pasteurellosis, rickettsiosis, necrobacillosis, and leptospirosis. This phenomenon illustrates the decisive role of anthropogenic factors in the spread of pathogens from the natural state into inhabited areas. By means of synanthropic vertebrates and domestic animals, new reservoirs of the disease are formed and sustained. The prevailing epizootic situation is of great interest from the viewpoint of epidemiology as well as epizootology. Therefore, to control these diseases, better diagnostic methods should be developed and made compulsory by law for the hunting of fur-bearing and other animals.

PATHOGENS AND DISEASES OF FUR-BEARING ANIMALS IN BYELORUSSIA

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The diseases in the farm-bred fur-bearing animals of Byelorussia were studied by A.E. Khrutskii (1971, toxic hepatic dystrophy of minks), A.E. Khrutskii and L.Ya. Davidchik (1972, listeriosis of minks), A.S. Shashen'ko, N.A. Kovalev, and A.E. Khrutskii (1975, rabies), and V.P. Boiko (1975 and 1977, botulism and distemper of minks)

Toxic hepatic dystrophy has been found to be prevalent in minks on the fur farms of the Republic. The etiology and pathological changes due to this disease have been studied and the consequent economic losses worked out. It has been demonstrated that feeding sodium selenite provides prophylaxis against natal gangrene of the uterus in minks. The role of the cocenotic action of *Listeria* and anaerobes in its pathogenesis has been described. The food products provided on the farm are the source of listeriosis in minks, while rooks and martens are the natural vectors of the disease. The main sources of rabies are the red fox (72%), raccoon dog (12%), badger (1%), and wolf (2%).

Microscopic, bacteriological, and serological investigations of blood and observations of the visceral organs of over 5,000 wild vertebrates inhabiting Byelorussia revealed 49 types of pathogens. Of these, 27 were found in birds, 16 in insectivores, and 15 in rodents and double-toothed rodents. Of these, again, 24 types were distributed exclusively among birds and only five types among rodents and double-toothed rodents. Two types were isolated from birds, rodents, double-toothed rodents, and insectivores, one type from birds, rodents, and double-toothed rodents, and nine from rodents, double-toothed rodents, and insectivores.

Among those isolated were pathogens of natural focal diseases. Thus, the pathogen of toxoplasmosis found in humans and many types of animals was detected in seven types of vertebrates. This includes its isolation from the lungs of the common squirrel, from the heart, liver, lungs and kidneys of lynxes, from the kidneys of moles, and from the heart of capercaillie. Serologically, toxoplasmosis was established in 30 farm animals (pigs, cattle, and sheep). In susceptible regions, the pasteurellosis pathogen was found to be transported by the black grouse, coypu, European hare, and four other types of vertebrate wild fauna. Its spread by foxes was as high as 62.5%. The presence of a leptospirosis reservoir was detected around an inhabited area.

was also detected in the intercellular space. The complex of the enzymatic fraction of the antibodies containing IgG revealed the wide-scale presence of viral antigen in a large number of cells.

Thus, the immunoperoxidase method can be successfully used to identify the canine distemper virus and also as a diagnostic test.

USE OF IMMUNOPEROXIDASE TAGGING FOR DETECTING THE CANINE DISTEMPER VIRUS

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In virology, the immunoperoxidase method is increasingly being used along with immunofluorescence

The advantage of this method, compared with the immunofluorescence method, is its greater specificity and sensitivity, the longer life of the reagents, and the use of ordinary light microscopes. The antibodies, tagged with peroxidase, have a low molecular weight and can easily penetrate the cell structure. On histochemical examination of the enzyme, the reaction products have stability and significant electron density, which enable the investigations to be carried out on an electron microscope.

The object of the present paper is to prepare a specific immunoperoxidase conjugate and use it to detect the canine distemper virus.

A portion of pure antibodies containing IgG and unpurified gamma-globulin fractions, prepared from the hyperimmune serum of blue foxes, were tagged with peroxidase (made in England by a biochemical firm). The protein concentration in both preparations was 4 mg/ml, 2 mg peroxidase was added to 1 mg of protein. A freshly prepared 1% solution of glutaric dialdehyde was used as the fixative. The mixture was thoroughly mixed for three hours and dialyzed against a buffered physiological solution. The conjugates obtained after centrifuging at 3,000 r p m for 15 min were used in the investigations.

A culture of the cells of chicken embryos grown on cover glasses was infected with the canine distemper virus (668-KF strain). An uncontaminated cell culture as well as a culture of cells processed by untagged hyperimmune serum, served as the controls. The direct method was used.

The specific conjugate obtained was added to the samples fixed in cold acetone (-20°C) and dried in air, and allowed to stand in a humid chamber at 37°C for 1 hr. The combined enzyme activity was determined by benzidine sulfate in the presence of hydrogen peroxide. The specimens were studied under a light microscope.

It was found that the nucleus and cytoplasm were the points of localization of the distemper virus in the culture of chicken embryo cells. In the nucleus, the virus was localized in the form of a few dark brown granules scattered in the nucleoplasm and small to large accumulations in the cytoplasm. When the infection was at a much later stage (fifth day), the virus

QUICK DIAGNOSIS OF NEUROVIRAL INFECTIONS IN SILVER-BLACK FOXES

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Aujeszky's disease is among the more widespread neuroviral infections present in silver-black foxes (Lyubashenko and Grishin, 1959 and Nikitin and Bazylev, 1967). Several instances have been recorded of animals suffering from rabies after having consumed infected meat (Manacharov, 1960). These infections sometimes inflict serious economic losses on the fur farms.

The successful control of neuroviral infections depends mostly on the introduction of a rapid intravital diagnostic method. At present, however, diagnosis of neuroviral infections is based only on the clinical picture and thus is only of limited importance. Laboratory methods are not available for intravital diagnosis.

We studied the possibility of diagnosing Aujeszky's disease and rabies in silver-black foxes by immunofluorescent investigation of the cornea and oral mucosa.

Tests were carried out on 45 animals, 27 of which were infected with the virus of common rabies and 8 with the virus of Aujeszky's disease, three animals were vaccinated against Aujeszky's disease and rabies, while four animals did not have any infection or protection.

The cornea and oral mucosa were investigated using a specific conjugated gamma globulin before the appearance of the clinical symptoms of the disease, in its early stages, and on postmortem. To obtain reliable results, no less than 200-400 epithelial cells of the animals were examined each time.

The results established the presence of bright greenish yellow foci the size of hardly visible dust particles 2μ or more in the protoplasm of the epithelial cells of infected animals. The shape and number of these in the cells varied widely. In both the infections, for one to three days before the appearance of clinical symptoms and in the initial stages of disease, 11-15% of the cells had bright foci. As the infection progressed, this rose and it went up in several cases to 30-35%.

Corneal cells with this form and brightness in isolated foci were seen in healthy and in vaccinated animals, as well as in the test animals before infection or in the first few days of the incubation period. However, their number was insignificant and did not exceed 1-9%.

Based on the results of these immunofluorescent investigations of the cornea and oral mucosa, a positive diagnostic method for Aujeszky's disease

EXPERIMENTAL INDUCTION OF SELF-BITING IN SABLES

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Self biting was induced in farm bred sables by inoculating suspensions from the brain and internal organs of sick animals by different methods

The incubation period was inconsistent and ranged from 25 to 425 days (period of observation) According to our data, it depended on the method of injecting the suspension

Self biting was also successfully induced in sables by using the material from sick animals inoculated in hamsters and in a culture of POZM and PKh cells The incubation period was sometimes shorter than on infection by suspensions from sables

The clinical and pathological (damage on fresh side) changes in experimentally infected sables were identical to those in sables infected spontaneously There was no close correlation between the disease symptoms and the damage on the flesh side

No typical pathological changes could be detected in the internal organs of experimentally infected sables, or in the spontaneously infected animals

DISTRIBUTION AND LOCALIZATION OF ENTERIC VIRUS IN THE ORGANS OF INFECTED MINKS

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In order to study the distribution and localization of enteric virus in the organs and tissues of minks, some animals were infected orally with 1 ml of a 10% suspension of mucous pipes containing 10^6 ID₅₀ enteric virus. Twenty-four hours after the appearance of clinical symptoms of the disease (diarrhoea, feed aversion, mucous pipes, etc.), the minks were killed and bits of liver, spleen, mesenteric lymph nodes, lungs, kidneys and portions of small and large intestines were collected under aseptic conditions for investigation. The tests covered eight minks. Similar samples were simultaneously collected from four control animals.

A 10% suspension was made of the test samples in Lari's solution; antibiotics were added (penicillin and streptomycin at 1,000 units per ml), and the sterility tested an hour later. The suspension thus prepared was used for further 10 fold dilution.

Virus titration was carried out on minks and on pretrypsinized cultures of the renal cells of kittens. A 10% suspension was used for diffusion precipitation in agar gel to identify the virus present in the organs.

The test results showed that the maximum amount of virus was contained in the small and large intestines (10^6 ID₅₀ and 10^6 TTsD₅₀ per ml) and in the spleen and mesenteric lymph nodes (10^4 ID₅₀ and 10^5 TTsD₅₀ per ml). The smallest amount was in the lungs, liver and kidneys (10^2 to 10^3 ID₅₀ and 10^3 TTsD₅₀ per ml).

Diffusion precipitation in agar gel was least sensitive for identifying the virus in the organs.

and rabies was applied to all the infected animals one to three days before the appearance of the first clinical symptoms of the disease

The results showed the promising possibilities of this method for diagnosing neuroviral infections on fur farms

units should be observed. Products of animal and plant origin should undergo bacteriological investigation so as to detect pathogenic micro organisms. The use of feeds containing the disease pathogens in an unsterilized form should be banned.

EPIZOOTIC ASPECTS OF THE PATHOLOGY OF INFECTIONS IN MINK

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Much attention is being paid to the development of mink breeding in the country. There is a massive increase in production, and the material base for this industry is being strengthened and improved. This increase in production calls for strengthening the feed base and identifying new feed sources. Along with this, there should be a predominance of meat fish groups of feed for these fur-bearing animals. Under Primorye conditions, the rations include the meat of whales, walrus, harp seals, horses, byproducts, fish and fish wastes, milk, cheese, and plant feed.

The data gathered by the author and the information available in literature show that the feeds used in mink breeding can contain pathogenic micro-organisms and be the source of infection. *Pseudomonas* and pseudotuberculosis bacteria can be present in plant feeds while the pathogens of coli bacteriosis, salmonellosis, pasteurellosis, erysipelas, leptospirosis, pseudomonias, pseudotuberculosis, anaerobic and other infections can be introduced by feed of animal origin. Whale meat is known to have a diversity of pathogenic micro-organisms. 32.5% of the samples of this animal contained intestinal bacillus, 22.5% *Salmonella* sp., 2.5% *Pasteurella* sp. and 2.5% showed the pathogens of anaerobic infections (80 samples were tested). A high level of infection was seen in the byproducts: intestinal bacillus was isolated in 52.1% of the samples tested, *Salmonella* in 12.6%, *Pasteurella* in 18.3% and *Pseudomonas* in 5.6%.

The epizootic state in mink breeding depends on the epizootic status of the farm animals in territories which have any ecological association with the mink breeding farms. The infection causing agents can be transported over long distances through feed sources. Apart from the products obtained by processing the slaughtered animals, the pathogens can get onto a mink farm through the rodents that inhabit the sheds in large colonies. Confirmation of the positive ecological associations with the pathology of infection is provided by the correlation between the results of investigating the rodent feeds, rodent carcasses, and dead minks.

In light of this, general farm measures and specific veterinary sanitary measures should be implemented. Special attention should be paid to measures which would prevent the import on to the farm of animal products coming from affected areas. Simultaneously, there should be systematic extermination of rodents, and the rules intended for the closed-type of farm

LEVEL OF HUMORAL FACTORS IN NONSPECIFIC IMMUNITY DURING SOME INFECTIOUS DISEASES OF BLUE FOXES

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A study of the state of nonspecific immunity factors in parasitogenic diseases is of great theoretical and practical interest. It is useful primarily in studying the pathogenesis of these diseases and in understanding the mechanism of the action of the parasite on the host and also in determining their physiological importance.

Diphyllobothriasis and toxascariidosis are widespread among blue foxes, even when farm bred.

The object of the present investigation was to determine the influence of the above infections on the activity of complement lysozyme, and beta lysine in the blood serum. Morphological (leukocytes, differential blood count erythrocytes and hemoglobin) and biochemical composition (total protein and protein fractions) of blood, live weight of the animals, and their pelt quality were studied simultaneously in sick animals and in healthy (control) animals.

Complement was most reactive in blue foxes suffering from diphyllobothriasis. Two months after the first infection, and 30 days after an additional attack, its activity dropped by 20% compared with its original level, while it remained relatively stable in the control animals.

Beta lytic activity in the blood serum of experimental and control blue foxes rose simultaneously, and the difference between the groups was insignificant.

Moreover, no differences in lysozyme activity between the experimental and control groups could be established, by the end of the first month, its activity rose by 40-4% but a month later it dropped by 63-7%.

During toxascariidosis, complement activity was at a comparatively high level, surpassing the control level by 14-9% in kits aged five months.

Beta lytic activity was 14-2% higher in three month-old kittens suffering from toxascariidosis than in the healthy ones, a month later, it dropped by 11-3% and by the age of five months it had risen to the initial level. At that time the activity of beta lysines was 18-3% higher in the control animals than in the sick ones.

The dynamics of lysozyme in the animals suffering from toxascariidosis corresponded to the dynamics noticed in the control group of animals. It surpassed the normal level in three month-olds by 10-8%.

QUALITY CONTROL OF DISINFECTION ON FUR FARMS DURING TUBERCULOSIS

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1 The pathogen of tuberculosis can remain for a long time in the external environment on fur farms prone to tuberculosis. This poses a potential danger to healthy animals as well as to the working personnel. Therefore, when implementing antituberculosis measures on fur farms, the contamination of equipment and the environment by pathogenic *Mycobacterium* should be taken into consideration, since unsterilized objects can provide the source for a fresh outbreak of tuberculosis among healthy animals and men.

The use of classic methods of isolating *Mycobacterium* from such objects is difficult because of several biological characteristics of the tubercle bacillus.

At present, quality control of disinfection in the buildings housing animals affected by tuberculosis calls for detection, not of the tuberculosis pathogen, but of the *Staphylococci* (Tsoi, 1969). The use of this method is almost impossible on farms.

2 An accelerated method was developed by the Department of Microbiology and Virology (Kondyurin and Kolychev, 1976) to produce tubercular microcultures on glass in liquid nutrient media with the addition of 10-15% cattle serum. This was tested for use in identifying tubercle bacillus in environmental objects and for the quality control of disinfection.

In these tests, the microcultures enabled the presence or absence of tubercular pathogen to be identified in the test objects within 5 or 6 days.

A scheme has been developed to collect samples of environmental objects for testing the presence of tuberculosis bacilli before and after disinfection.

3 A hundred scrapings from the cages, houses, soil, passages between sheds, and other places on various farms have been studied. The farms covered in the study were Imantavsk, Kazakh Soviet Socialist Republic, Salutaguza, Estonian Soviet Socialist Republic, and the Rechnay, Orlovskii, and Mayak cooperative farms in the Omsk region.

Fifty-nine strains of *Mycobacterium* sp. were detected. Of these, nine (15.2%) were bovine, six (10.2%) avian, and 44 (74.6%) acid-resistant saprophytes.

This shows the epizootological importance of the objects on fur farms in which virulent *Mycobacterium* sp. have been detected.

CURATIVE EFFECT OF IMMUNOLOGICAL DEPRESSORS ON MINKS SUFFERING FROM ALEUTIAN DISEASE

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Aleutian disease (AB) of minks (viral plasmocytosis) is an infectious disease inflicting serious losses on fur farms. Until now, there has been no effective means of controlling it. We attempted to use immunological depressors as curative media during viral plasmocytosis in minks. The use of these was started in the late stages of AB, when hypergammaglobulinemia was clearly manifested. This work was based on the finding that necrotic infection of the tissues of sick animals, arteritis, and glomerulonephritis were caused not by the AB virus itself, but its complexes with antibodies and that the formation of immune complexes did not inactivate the AB virus.

A reduction in the amount of circulating antibodies could therefore be expected to lead to a reduction in the amount of specific complexes and a reduction in the pathological effects on the minks. Our results attest to the correctness of such an approach.

Injections of metotrexate were given to the sick minks intramuscularly once every 48 hr for 14 days. The second course started two weeks later. Immediately after the third course of injections, the minks were killed and subjected to histological analysis.

However, under field conditions, intramuscular injections were inconvenient and metotrexate produced some side effects: chromosome disturbances and lipid dystrophy of the reticular stroma in the lymphoid organs. In the next series of experiments, therefore, the immunological depressor 6-mercaptopurine was used. This could be administered to the minks orally with the feed and it was less toxic. In both cases, there was a significant reduction in the mitotic activity of the lymphoid tissue and a reduction in plasmocellular infiltration of the liver in the experimental minks compared with the controls.

Thus, there is some basis to presume that immunological depressors can be successfully used as curative media for controlling viral plasmocytosis in minks and thus keep them alive until the time of slaughtering.

A combined invasion had a more pronounced effect on the blue foxes. Specially significant deviations from the normal were seen in the system of beta lysines. A month after diphyllbothriasis infection in kittens already suffering from toxascaridosis, the activity of beta lysines was 20 % higher than in the control group of animals.

The complement activity tended to rise in sick animals, while the lysozyme activity in sick animals corresponded to that in healthy animals.

After eradication of helminths, all of the indices of the animals approached normal values.

MORPHOLOGICAL AND FUNCTIONAL CHANGES IN MINKS DURING EXPERIMENTALLY INDUCED MYCOTOXICOSIS

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Earlier, the authors had found certain morphological and functional changes in minks under experimental staphylococcal and colibacterial infections

The present investigation is concerned with a study of the morphology and function of several organs in minks under experimental mycotoxycosis

The test covered 60 minks, which were fed toxic *Aspergillus niger* and *Fusarium sporotrichiella* fungi along with their normal rations for 30-45 days

The test animals were subjected to clinical observations and biochemical investigations of blood serum, urine, and feces. Pathological autopsies were made on the slaughtered minks and material was gathered for histological investigations (kidneys, liver, lungs, heart, and skeletal muscles) and for histochemical investigations of myoglobin (heart and skeletal muscles). In all, histological and histochemical investigations were made on the material collected from 18 minks

Digestive disturbances were noticed in the experimental animals: diarrhoea, loss of appetite, and poor digestibility and absorption of nutrients. Fecal examination showed an increase in organic acids (18.6 units) and ammonia (11.6 units), thus revealing intense fermentative-putrefactive intestinal processes. Further, a positive or sharply positive Tribble reaction was established in the soluble protein, microscopic examination revealed a large number of epithelial cells, mucous, particles of undigested food, fat drops, and blood elements

Along with these, disturbances in the functional state and morphology of the kidneys and liver were established. The blood of minks showed an increase in bilirubin to 0.58 mg%, aspartate transferase to 112 units, alanine transferase to 51.6 units and cholesterol to 347.9 mg%, and a reduction in total lipids. Qualitative tests of urine established the presence of protein, sugar, myoglobin and increased urobilin to 5 units. Histological tests of the kidneys and liver showed changes in the nature of protein and lipid dystrophy.

Histochemical investigations by the Verbovovich method established dissimilar concentrations and localization of myoglobin in the transverse-striate musculature. While a normal structure of muscular tissue and a corresponding normal distribution and concentration of myoglobin were

REACTIVE HYPERPLASTIC FOCI IN COYPUS

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Loci of reactive hyperplastic processes (ORGP) in healthy standard coypus have not been adequately studied in regard to their physiological diagnostic features. Recently, these formations began being increasingly examined, along with the intensity of immunity and the production of properdin (Anderson, 1961, Sheremeta, 1969, and Gerbert, 1974).

In the present investigation, histological and histochemical studies of ORGP were carried out in the liver, kidneys, lungs, and myocardium of healthy standard coypus (61 observations).

The general and specific methods of histological staining and histochemical reactions (hematoxylin-eosin according to Linserson, Shabadash, Kheil, Margolin, Perl, and others) were used. The presence, generalization, intensity, localization, and cellular composition of ORGP were studied under a microscope (with an evaluation of the degree of proliferation intensity using tentative units).

As a result, ORGP were identified in 85.2% of the healthy standard coypus studied (83.6% in the tissues of lungs, 53.3% in the liver and 12.2% in the kidneys). The generalization of ORGP (their simultaneous presence in several organs) was limited usually to two organs (10.7%) and rarely to three organs (1.7%). The intensity of cell proliferation varied: in the lungs it was 1.54 tentative units, in the liver 1.06, and in the kidneys 1.0. The ORGP in healthy standard coypus were characterized by uniform localization. In the lungs, they were usually located peribronchially and perivascularly, in the periportal fields of the liver they were around the "triad", and in the kidneys they were found at the level of convoluted tubules. Cytologically these formations were monomorphic in composition. They were seen as circular cells corresponding in size and structure to lymphocytes, and having a negative reaction to myelo-oxidase and hemoglobin pigments.

These characteristics of the visceral organs should be taken into consideration in any histological study of this species. They are useful for understanding the phenomena and for evaluating the intensity of morphological immunity substratum during the process of histological diagnosis of the disease accompanied by shifts in immunological homeostasis.

ALUGAN—AN EFFECTIVE MEDIUM FOR THE CONTROL OF SARCOPTIC AND EAR MANGE IN SILVER BLACK AND BLUE FOXES

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Sarcoptic and ear mange is a frequent disease attacking silver-black and blue foxes on the fur farms in the Soviet Union. In recent years, large-scale outbreaks of sarcoptic mange were found in blue and silver-black foxes on the Rybnovsk fur farm of the Ryazansk regional consumer cooperative. There 65% of the silver-black foxes and 53% of the blue foxes were affected. On the Sokal'sk fur farm on the Lvov regional consumer cooperative, 5% of the silver-blue foxes were affected.

Otodectic mange was encountered on many fur farms, where the incidence of ear mange was as high as 50%.

Sarcoptic and ear mange of silver-black and blue foxes adversely affects the profitability of fur farms because of the death of animals, female infertility and weakened sexual activity in males, impaired pelt quality, and premature elimination of valuable stock. Moreover, these parasitic skin diseases can promote the origin and rapid spread of ringworm among the animal population.

Alugan (made in the Federal Republic of Germany) is an extremely effective and nontoxic acaricide for the control as well as the prophylactic treatment of sarcoptic and ear mange mites parasitizing silver-black and blue foxes. Dip baths, containing a 0.1% aqueous suspension of Alugan concentrate, were used for treatment. Tests, using this concentration, on *Acarus siro* and *Notodres cati* established the highly effective acaricidal properties of this chemical. The mites died within an hour when the experiments were conducted *in vitro* and the effect of this acaricide persisted for as long as 13 days. However, Alugan exhibited weak ovicidal properties in the above concentration.

The innocuity of Alugan was tested by external application of a 0.1% aqueous suspension of Alugan and also by administering different dosages of it internally, with the feed. Ten red foxes bathed in a 0.1% aqueous suspension of Alugan did not reveal any abnormal deviations (feed aversion, depressed state, etc.). Oral administration of the preparation to the host animals at doses of 20, 40, 60, and 80 mg per kg body weight did not cause any intoxication. However, a dose of 100 mg per kg body weight and above did cause toxicity.

A preparation of 2% Alugan in an oil base was used to control otodectic

found in some cases, structurally altered muscular fibers with disturbed distribution and concentrations of muscular pigment, along with normal muscular fibers, were found in some others

Thus, fungal toxicosis resulted in significant disturbances to the protein, lipid, carbohydrate, and also the pigmentary metabolisms among minks. A close association has been established between the morphological and functional changes in many organs. These morphophysiological changes caused by mycotoxicosis should be taken into consideration when working out etiopathogenetic therapy.

THE LEVEL OF NONSPECIFIC IMMUNITY IN MINKS IN RELATION TO GENOTYPE, AGE AND SEASON

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The age of an animal and the ambient conditions greatly determine the degree of intensity of various physiological functions, including the degree of its natural immunity (Berman, 1955, Novokreshchenov, 1961 Malafeeva, 1971, Ebert et al, 1971, Chemnyi, 1972, and others)

These investigations studied the factors of natural protection in minks belonging to three color genotypes, white, silver blue, and sapphire, aged 2, 3, 4, 5, and 6 months and adults in different seasons of the year. Humoral indices of immunity, i.e., lysozyme, beta lysine, and complement, determined in the blood serum by common methods, have been used to describe the immunity level.

Investigations showed that lysozyme activity was highest (94%), in white minks aged two months. At the age of 3, 4, and 5 months, its level gradually dropped to 79% and at six months it was 89%. It was 81% in the adults.

Silver blue minks also recorded a maximum activity at the age of two months, i.e., 112%. At the age of 3, 4, 5, and 6 months and adulthood, it was low at 85%, 93, 89, 96 and 87%, respectively. In sapphire minks, the lysozyme level in the serum was 113% at two months and 98% at three months, it later varied from 89-95%.

The activity of beta lysines was 36.6% in two-month-old white kits. It rose to 42.5% by three months. There was a slight reduction in its level to 30.2% in the fourth month, 34.9% in the fifth month, and 34.5% in the sixth month. It was 28.1% in adult white minks. Silver blue minks were characterized by a high lytic activity of beta lysines at the age of 2 and 6 months (40.0 and 40.2%). It ranged from 33.2 to 38.6% at 3, 4, and 5 months. It was 33% in the adults. In sapphire kittens, the activity of beta lysines ranged from 30.4 to 42.8%, with its highest level at six months. It was 31.7% in the adults.

Complement activity (in $S'N_{50}$ units) in the blood serum was highest in two-month old kittens at 33.8 in white, 34.8 in silver blue and 30.6 in sapphire minks. The activity gradually dropped in the later period of post embryonic growth, and at the age of five months was respectively equal to 25.7, 22.0 and 28.1 with a rise at the age of six months to 26.2, 27.3 and 31.9 units. In

mange The host animals were treated with this acaricide only once by pouring 1.5 to 2.0 ml of the warm (30°C to 35°C) suspension in each ear *Otodectes cynotis* were dead in 3 hr and the duration of acaricidal effect lasted for 15 days

The success of controlling ear mange in fur-bearing animals depends on the thoroughness of the treatment Animals with a very high degree of infection with ear mange should be secluded and subjected to a second treatment after an interval of 5 to 7 days

The treatment of the host animals for otodectic mange is best carried out before the beginning of summer In December, disinfection of the cages is not required since these mites rapidly perish on exposure to the cold environment

During 1976 and 1977, 800 silver-black and 1,000 blue foxes were treated with 2% Alugan against otodectic mange at the experimental farm of the Institute of Fur Farming and Rabbit Breeding No complications were found in the treated animals

Thus, a 0.1% aqueous suspension of Alugan can be successfully used to treat fur bearing host animals for sarcoptic mange (before summer) and *Otodectes cati* A 2% oil suspension of Alugan shows distinct acaricidal property and can be used as a nontoxic and potent acaricide for the control of ear mange in fur-bearing animals

NONSPECIFIC IMMUNITY DURING ALEUTIAN DISEASE IN MINKS OF DIFFERENT GENOTYPES

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Recent investigations have established the dependence of the genesis, course, and progress of several infectious and somatic diseases on the state of the natural protective resources of the organism. They have also demonstrated the possibility of using nonspecific tests for prognosis and diagnosis and also for evaluating the efficiency of treatment.

As pointed out by several authors, these investigations become even more important, when experts have to deal with diseases the pathogenesis of which has not been thoroughly studied. Among such diseases found in fur-bearing animals in Aleutian disease or viral plasmocytosis, an immunological disease in minks arising as a result of persistent viral infection.

Although achievements have been made in recent years in the study of its pathology, many aspects of its pathogenesis still remain vague.

The present work provides data on the state of the natural protective forces during viral plasmocytosis among white, silver blue, sapphire, and standard minks.

The humoral factors of immunity, i.e., lysozyme, beta lysine, and complement, have been used as factors reflecting the level of nonspecific immunity. These values have been determined in the blood serum of 2, 3, 4, 5-, and 6-month olds and in adult animals by the usual methods, in sick and healthy animals simultaneously.

Diagnosis of the disease in live animals has been made by electrophoretic fractionation of serum proteins, thymol and iodine tests followed by pathological autopsy after killing the animal or after the death of the animal.

The results of these investigations showed that lysozyme activity in the blood serum of sick animals of colored genotypes was usually higher than that of healthy animals. It ranged from 8.5–11.6% in white, 9.6 to 12.6% in silver blue and 8.9–13.1% in sapphire minks during the test period. The lysozyme activity in sick standard minks was 13.6% higher than that in healthy animals at the age of five months, while there was no significant difference between normal and sick animals at six months of age.

No distinct patterns on beta lytic activity in the serum were noted. Also there was no significant difference of its activity between the sick and healthy white minks (16.9–43.3%). In sick silver blue minks, it was somewhat lower

adult minks of the genotypes under study, the complement activity ranged from 22.5-25.1

Seasonal lysozyme dynamics in adults were similar to those in minks of all the genotypes under study: the highest lytic activity of serum was noticed in winter (8.8-11.2%), dropping to a minimum in the spring (7.4-7.7%), it increased in the summer, but dropped in the autumn.

The dynamics of beta lysines were exactly opposite: their levels rose in the spring to their highest values (32.8, 42.2, and 44.5%) and dropped in the summer to a minimum (24.6, 24.5 and 17.4%).

The serum complement activity gradually rose in the winter-spring-summer period to 26.9 in white minks, 33.3 in silver-blue minks, and 34.6 in sapphire minks, while it dropped to its lowest level in the autumn, to 18.9, 20.7, and 20.0, respectively. Much higher humoral immunity indices were noticed in sapphire minks than in the silver blue and specially the white minks.

TOXOPLASMOSIS INVASION IN FUR-BEARING ANIMALS AS REVEALED BY IMMUNOLUMINESCENCE REACTION FOR COMPLEMENT FIXATION

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Toxoplasmotic invasion of fur-bearing animals, like other acute and chronic infections, accounts for serious losses on fur breeding farms. The significant polymorphism of the clinical symptoms of toxoplasmosis in animals and the presence of latent forms of this infection render clinical diagnosis of this disease difficult.

The use of immunological tests with a high specificity helps in analyzing complex epidemiological and epizootological factors.

Unfortunately, not all serological methods are used to the same extent in diagnosing toxoplasmosis in man and animals. The immunofluorescence reaction (RIF) for identifying antitoxoplasmotic antibodies has been widely used in recent years. However, RIF (indirect variant) for the diagnosis of toxoplasmosis in animals is still not widely used, since antispecific antiglobulin luminescent serums are not available in the required quantities.

We studied the possibility of using other immunoluminescent methods for the diagnosis of toxoplasmosis in the serum of fur-bearing animals.

Serological investigations were carried out on the blood serum of blue foxes and minks at the Belomorsk, Kondopozhsk, Pryazhensk, and other state fur farms.

The serum of the animals was simultaneously tested for two immunological reactions, i.e., complement fixation (RSK) and fluorescent complement fixation (RFSK). The latter, carried out by the Goldwasser and Jacquard method (1958), is based on complement fixation by an antigen-antibody complex and subsequent identification of the bound complement using a specific luminescent antibody.

Investigations revealed that all the serological tests used had a high specificity, but the sensitivity of these methods was not the same.

According to the RSK data, toxoplasmosis was identified in 84% out of a total of 402 minks investigated. Out of 397 blue foxes tested, 98% were found to be infected.

The RFSK was found to be more sensitive for the identification of antitoxoplasmotic antibodies in farm-bred animals. Thus, according to the RFSK data, the presence of specific antibodies was noted in 189% of the minks and 161% of the blue foxes. Toxoplasmosis in fur-bearing animals

than in the controls at 2, 3, 5, and 6 months of age (5.0 to 38.4%), in sick sapphire minks, it was lower at the age of 2, 3, and 4 months and adulthood, and high in 5- and 6-month old animals (13.1-56.7%). It tended to rise in standard minks at the age of four months and, a month later, rose by 26.3% over the value of the corresponding controls.

Determinations of the complement activity (in S^1N_{50} units) are of utmost interest. In all the age groups tested, its level was significantly higher in colored sick minks than in the control group: it was 36.6-49.7 in white, 43.5-73.2 in silver blue and 41.0-77.4 in sapphire minks. This index tended to rise in sick standard minks 4 and 5 months of age, while in two month-olds it exceeded the normal level by 11%.

Thus, data were obtained on the state of nonspecific humoral immunity factors in minks of different genotypes during Aleutian disease. In the sick animals, all of the indices showed a marked change, thus confirming their effect on the development of the pathological condition.

DERMATOMYCOSIS IN FARM-BRED FUR-BEARING ANIMALS

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Dermatomycosis has begun to be seen quite often in farm-bred fur-bearing animals. The disease diminishes the commercial quality of the fur product, puts the sale of pelts at a disadvantage, and adversely affects the supply of good stock. The possibility of this disease occurring in the workers cannot be ruled out.

Infection by trichophytosis and microsporadia has been recorded among silver-black and blue foxes, but not among minks and sables. All age groups, starting from 20 days of age, are susceptible to these diseases. They are most widespread from June through September, i.e., the time the kittens are born.

Investigations of over 250 pathological samples from different farms have established that the main pathogens of trichophytosis are *Trichophyton mentagrophytes* (*T. gypsum*) (67%), *T. verrucosum* (*T. faviforme*) (17%) and *M. canis* (only 16%).

The sources of infection are the beddings and other material infected by rodents (*T. mentagrophytes*), slaughter-house wastes (*T. verrucosum*), and stray cats and dogs (*M. canis*). Many investigators were of the opinion that the rising incidence of *Microsporum* of fur-bearing animals among men was the result of a large number of stray cats. It is therefore important to take this epizootological factor into consideration.

To control dermatomycosis among fur-bearing animals, a more rational approach to a number of measures is needed. These measures include isolation and treatment of the sick, and prophylaxis of the entire animal population by administering the antibiotic griseofulvin at 10 mg per kg body weight along with the feed. Sick animals and those coming in contact with them should be given a dose (20 mg per kg). During the quarantine period, thorough disinfection is carried out by burning, and the use of caustic soda and formalin solutions, treatment of clothes, handling objects, and cages of mothers in a paraformaldehyde chamber, and destruction of the sick animals and those in direct contact with them.

Silver-black and blue foxes with spontaneous and experimentally induced trichophytosis acquire high immunity, which in principle, makes it possible to devise specific prophylactic measures.

was not the same on different farms and it evidently reflected the prevailing epizootological environment responsible for a given infection.

High indices of infection were noticed among blue foxes on the Syazovsk, Kuterzhok, and Tannanuk state farms (13.8-15.0% according to the RSK and 18.3 to 23.8% according to the RISK).

Low degrees of infection were identified among blue foxes on the Mikhailovsk, Pryachunsk, and Kondopozhok state farms (4.0 to 6.3% according to the RSK and 12 to 16% according to the RISK).

Whenever there is a lack of sanitary and hygienic conditions, there is a danger that the toxoplasmodic invasion in blue foxes and minks could be transmitted to the personnel working on the farms.

Thus, while inspecting the workers on one fur farm, it was found that 56.8% of the breeders, 33.3% of the mechanics, 34.2% of the helpers, and 20.5% of the students were affected by toxoplasmosis (according to data of the Communist Party).

Thus, the RISK is superior to the RSK in sensitivity, and it can be successfully used for diagnosing toxoplasmosis in fur-bearing animals.

MORPHOLOGICAL CHANGES IN THE CENTRAL NERVOUS SYSTEM OF HAMSTERS IN EXPERIMENTALLY INDUCED SELF-BITING

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The brain and spinal cord of 10 adult male golden hamsters, infected with a suspension of the brain matter of farm-bred sables affected by self-biting, were studied along with those of six healthy hamsters. Over the test period of six months, clinical symptoms of self-biting were noticed from time to time in the infected hamsters.

The investigations revealed that the pathological changes in the central nervous system of hamsters affected by self-biting were a sharp vacuolization, pyknosis and lysis of the neurons, the presence of nucleolus like inclusions in the nuclei, moderate proliferation, swelling and lysis of the astrocytes, and spongiosis with a definite localization.

Changes were detected in all sections of the central nervous system, and specially in the sensory areas of the brain. These were analogous to the pathological changes found in the brain of sables affected by self-biting, but they were more distinct in the motor nerves than in the sensory areas.

Damage to the parietal region of the cerebral cortex, lateral and ventral nuclei of the thalamus, and the rear group of the nuclei of the hypothalamus reveal the centralized localization of the processes occurring in the brain during self-biting.

Lymphohistiocytic infiltration of meninges, vasculosa karyopyknosis and karyocytolysis, vacuolization of the cytoplasm of neurons, and spongiosis are more pronounced in hamsters than in sables. This reveals the prolonged action of the viral infection in hamsters.

The pathological processes in hamsters, as in sables, are destructive, but they do not exhibit inflammation and are typical of encephalomyelitis.

Vacuolization of the cytoplasm of neurons, some pyknotic cells, and peripheral chromatolysis were rarely found in the brains of the control hamsters.

SULFAMONOMETHOXINE TREATMENT OF WETTING IN MINKS

R I Novolny

Agronom Special Farm, Khar'kov Region

In 1976, on the Izyumsk state fur farm, 10.1% of the males and 0.3% of the females suffered from wetting. The young juveniles usually suffered from this condition in August, September and October. In the main herd, the disease was found in 2.8% of the males and 0.3% of the females.

Treatment with sulfamonomethoxine followed two schemes.

1. The sick minks were given 1 g of sulfamonomethoxine internally on the first day of treatment, and 0.5 g for the following six days. All of the 15 minks under treatment recovered.

2. The sick minks were given 0.5 g on the first day of treatment and 0.25 g for the following six days. All of the 15 minks under treatment recovered.

No side effects were noticed from the sulfamonomethoxine. In 1976, the successful use of this compound for the treatment of wetting in minks enabled the Izyumsk state fur farm to produce pelts of high quality, without any of the defects common to this disease.

Table 1 Defects in pelts produced by the Izyumsk state fur farm in 1975 and 1976, percentage

Year	Normal	Defects			
		Low	Medium	High	Nonstandard
1975	32.8	41.4	18.9	6.0	0.9
1976	47.0	36.0	12.15	4.42	0.43

The expenditure for treatment with sulfamonomethoxine was 30 to 40 kopeks per mink.

On the Agronom special farm, sulfamonomethoxine was used to treat bronchopneumonia in coypus. Thirty-six coypus affected by bronchopneumonia were given 1 g sulfamonomethoxine on the first day and 0.5 g for the following nine days. All of the treated coypus recovered.

MORPHOLOGICAL CHANGES IN THE CENTRAL NERVOUS SYSTEM OF HAMSTERS IN EXPERIMENTALLY INDUCED SELF BITING

L. M. Petrova

Siberian Institute of Veterinary Research Omsk

The brain and spinal cord of 10 adult male golden hamsters, infected with a suspension of the brain matter of farm bred sables affected by self biting, were studied along with those of six healthy hamsters. Over the test period of six months, clinical symptoms of self biting were noticed from time to time in the infected hamsters.

The investigations revealed that the pathological changes in the central nervous system of hamsters affected by self biting were a sharp vacuolization, pyknosis and lysis of the neurons, the presence of nucleolus like inclusions in the nuclei, moderate proliferation, swelling and lysis of the astrocytes, and spongiosis with a definite localization.

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Inclusions were detected in the epithelial cells of the urinary bladder of the dead minks, thus being characteristic of canine distemper. All seven animals given the combined immunization remained active for 30 days after the infection. No symptoms of the disease were detected in them.

In 1976, a laboratory experiment was carried out on 19,500 minks to test the method of simultaneous vaccination against distemper and botulism on four farms of the All Union Consumers' Cooperative Society. For these immunizations anti-distemper preparations from the 668-KF and EPM strains and from the American vaccine were used, and the indigenous vaccine for botulism was used. No undesirable reactions or complications were seen in the animals given the two vaccines simultaneously, for four months (period of observation) after immunization. Simultaneous vaccination of minks against distemper and botulism had no adverse effect on the productivity indices of the fur farms.

Thus, our own data and those of specialists on the fur farms established the innocuity of combined vaccination of minks against distemper and botulism.

The positive results obtained in the experimental study and in field tests using the method of simultaneous vaccination of minks against distemper and botulism justify the recommendation of this method for extensive field tests.

SIMULTANEOUS VACCINATION OF MINKS AGAINST DISTEMPER AND BOTULISM

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A A Egorov

Main Administration of Fur Cooperative

During the time of large scale vaccinations, veterinary specialists working on fur farms face the need to immunize the animals against more than one infectious disease simultaneously. Because of the large volume of prophylactic inoculations to be given on susceptible farms, planned immunization of the animals often takes 12-14 days. Therefore we studied the possibility of using combined vaccinations of minks against distemper and botulism. This was done by administering test inoculations to study the immunological re-organization of the organism, by controlled infection of the inoculated animals to establish the duration and intensity of immunity, and by testing this method of vaccination extensively under field conditions.

The American vaccine for canine distemper and the indigenous Kandui "S" for botulism were used for immunization. The vaccines were administered separately, intramuscularly, in the inner region of the thighs.

A month after the vaccinations, daily observations were carried out on the test animals. All of them were active, fed well, and showed no difference whatsoever from the control group of animals. The body temperature of the simultaneously vaccinated minks was also recorded in the normal range for 15 days. All of the animals tolerated the combined vaccination well.

Seven days after vaccination a statistically significant increase in alpha and beta globulins was noticed in the blood serum of minks which had been given the combined immunizations. These values remained the same even 21 days after vaccination. Two months later, the protein composition of the blood serum in the experimental animals did not vary significantly from the corresponding indices in the control group of animals.

A high level of immunity to botulism toxin in minks given the combined vaccination was established 270 days (period of observation) after the inoculation. Minks immunized by this method remained active and without any visible abnormalities, even after administering 10,000 lethal doses.

The immunity developed in minks given the combined vaccination to the field strain of canine distemper virus was determined after six months. A suspension of virus-containing material was given intracerebrally to five controls, three died between the 11th and 17th days, and two became sick.

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SUSCEPTIBILITY OF FARM BRED MINKS TO INDUCED LISTERIOSIS

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Man and many other species of mammals and birds are susceptible to listeriosis. It is well known that certain diseases can be induced experimentally only by a specific method. Such work has not been reported in literature. Therefore, we experienced difficulties in selecting the dose and method of infecting the minks with listeriosis experimentally. Our object was to determine the minimal infecting dose and the method of parenteral administration of a culture of *Listeria* experimentally.

In the first test, a wash of a two day virulent culture of *Listeria* was administered subcutaneously to four minks at a dosage of 100 million microbes and to four others at one million microbes (optical standard). No abnormal deviations were noticed in the infected animals. All of the animals remained active for 10 days (period of observation).

In the second experiment, injection was given intramuscularly. Two minks were given four billion *Listeria* microbes and two others eight billion microbes. All of the animals remained active, even after this method of infection.

In the third experiment, 18 animals were given *Listeria* subcutaneously and in a semi liquid agar. The animals were divided into six groups of three animals each and were infected with increasing doses of *Listeria* 10, 20, 40, 80, 160 and 320 billion microbes. Further, one animal in each group was given 16 units of lydasa. The animals of the first and third groups remained active, while all of the animals in the fifth and sixth groups died 1 to 11 days after infection. The animals of the second and fourth groups infected with lydasa died on the fourth and eleventh days. Pure cultures of *Listeria* were isolated from the visceral organs and brain of the carcasses by providing the nutrient media. Evidently, the death of the animals in the last test was not due to the infectious process, but due to intoxication caused by the large number of micro organisms.

In the next experiment, two minks were given two billion *Listeria* microbes below the root of the tongue. This method was unsuccessful in inducing the infection. The animals remained active over a prolonged period of observation.

Similarly, the method of intravenous infection of minks by *Listeria* was tested. The vein in the upper one-third of the neck was opened under general

aminazinebarbamil anesthesia. Three minks remained active even after receiving 1, 2 and 5 billion microbes each intravenously.

The possibility of infecting minks irradiated by X-ray was studied. For this purpose, three animals were irradiated at the rate of 150 roentgens and then administered 90 billion *Listeria* microbes subcutaneously in 1.5 ml. Two minks died on the fourth and fifth days after infection, and one remained active for 30 days (period of observation).

Infection of the brain was tried by a method developed by us. All of the test animals died on intracerebral infection while the control animals remained active.

These studies thus show that farm-bred minks are extremely resistant to experimental infection of listeriosis. The infection was most effective in pre-irradiated animals and in those infected by the intracerebral method.

COMBINED VACCINATION OF BLUE FOXES AGAINST DISTEMPER AND AUJESZKY'S DISEASE

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Many investigations carried out by Soviet and foreign scientists have established the possibility of simultaneous application of several antigen preparations for the vaccination of man and animals

The object of the present investigation was to determine the possibility and effectiveness of the simultaneous application of vaccines against distemper and Aujeszky's disease

The test was carried out on 48 blue foxes divided into four groups. The animals of the first group were given the American vaccine for canine distemper and the GNKI dry viral vaccine against Aujeszky's disease simultaneously. The vaccines were given separately, intramuscularly on the inner surface of the thighs of both limbs. The foxes of the second group were given anti-distemper vaccine and those of the third group anti Aujeszky's disease vaccine. The animals of the fourth group served as controls.

The inoculated animals remained under daily observation for 30 days after vaccination. All of them fed well and did not differ at all from the unvaccinated controls.

To find immunological disturbances, the virus neutralizing antibodies, the content of protein fractions and the presence of "S" reactive protein, and the morphological indices of the blood were determined before immunization and 7, 14, 21 and 60 days after vaccination.

The titer of virus neutralizing antibodies for the virus of Aujeszky's disease in the blood serum of blue foxes was determined in a culture of FLK cells (fibroblasts of chicken embryo). Fourteen days after vaccination, the titer of antibodies in blue foxes simultaneously vaccinated against canine distemper and Aujeszky's disease was half that in foxes vaccinated only against Aujeszky's disease. In subsequent investigations, the titers of antibodies in the first group of animals rose to the level established in the animals of the third group, and remained at that level.

In the blood serum of simultaneously vaccinated blue foxes, a statistically significant rise in the alpha globulin fraction in the protein was seen on the seventh day after vaccination. In the animals given single vaccinations, a significant increase in gamma-globulin was seen 7 and 21 days after vaccination.

In blue foxes of all groups, before immunization and 7, 14 and 21 days after vaccination against distemper and Aujeszky's disease, no differences were found in the content of "S"-reactive protein in the blood serum

In blue foxes vaccinated simultaneously, the amount of neutrophils rose by 10% on the 14th day after immunization, as compared to their original level, but they did not exceed, on the average, more than 44%. The eosinophil content was 1-3% and basophils 1-2%

Sixty days later, all of the indices of the immunized animals approached those of the controls

In order to determine the intensity of immunity, the immunized animals were exposed to controlled infection. Three months after vaccination, seven blue foxes of each group were infected intracerebrally with a suspension of brain tissue containing the field strain of Aujeszky's disease virus in a dilution of 1:10. All the control animals died on the third and fourth days after infection, four each died from the first and third groups on the fourth to the eighth day, while three foxes in each group remained alive.

Five months after vaccination, blue foxes of the first, third, and fourth groups (seven each) were injected with canine distemper virus (Gauyazskii strain) in the brain. All of the infected animals remained alive for 30 days (period of observation) while all the control animals died on the tenth to the sixteenth day after infection.

These investigations on simultaneous vaccination of blue foxes justify the conclusion that the method of combined immunization is innocuous to blue foxes and further the intensity of immunity in the vaccinated animals is no different from that in animals given these vaccines singly.

BILE ACIDS IN MINKS AND BLUE FOXES

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The composition of bile acids was studied using the bile of farm bred standard minks and blue foxes on the Kondopozhsk fur farm. Since bile acids are produced by the hepatic cells, their content in the bile serves as a reliable index of the functional state of the hepatic parenchyma. We compared normal and sick animals. All of the animals were kept on normal rations. They were not fed before slaughtering, and both groups were slaughtered simultaneously. The selection of sick and healthy animals was based on clinical symptoms (total protein composition, and protein fractions). At the end of the test, diagnosis was confirmed by autopsy. The gallbladder contents were mixed with 7 to 10 times their volume of ethyl alcohol and stored in this form in a refrigerator until taken for analysis. Quantitative determination of bile acids was done by spectrophotometry developed in our laboratory (Rypatti et al., 1969).

Bile acids were studied in the bile of minks suffering from plasmocytosis. They were divided into two categories: the first group comprised sick but untreated animals while the second group consisted of sick animals which had been given parenteral doses of 6 mercaptopurine (6-MP) at 2.5 or 5.0 mg per kg body weight. Minks were given three doses, one after every alternate 14 day period for three months. The test blue foxes were infected with broad tapeworm. Healthy animals served as controls.

The main constituent of bile acids in the bile of both groups of animals was cholic acid, which in minks was $83.3 \pm 2.2\%$ of the total bile acids and in blue foxes $71.4 \pm 3.2\%$. The content of these acids in the gallbladder of healthy minks averaged 25.2 ± 5.3 mg and of blue foxes 123.9 ± 41.0 mg. In the bile of sick minks, there was some reduction in this value to 19.8 ± 11.1 mg. There were wide individual variations in bile acids and in cholic acid in the bile of healthy as well as sick animals. Their percentage was, however, more stable in relation to the weight of the total lipid fraction of the bile. The variability coefficient of total bile acids in healthy minks was 21.7% and in sick animals 3.0%. Evidently, in a liver disorder, the bile secreting function still continued though the sharp reduction in the variability coefficient suggests the approach of maximum compensatory possibilities.

Treatment with 6-MP led to an increased concentration of bile acids. The dose of 5.0 mg was particularly sensitive and doubled the level of bile acids and cholic acid.

In blue foxes infected with broad tapeworm, a significant increase in bile acids was noticed (by nearly twofold) in the bile, while at the same time, the proportion of cholic acid dropped to $59.2 \pm 2.1\%$. This agrees with the suggested possible role of bile acids, specially deoxycholic acid, in the control of some intestinal parasites (Smyth, 1962 and Smyth and Haslewood, 1963)

THE POSSIBLE SPREAD OF INFECTIONS CAUSED BY PATHOGENS OF THE FAMILY CHLAMYDIACEAE ON FUR FARMS

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According to the latest classification of vertebrate viruses, the following belong to the family Chlamydiaceae the pathogen of ornithosis affecting birds other than Psittaciformes, psittacosis of Psittaciformes, meningopneumonia, venereal lymphogranuloma, trachoma, enzootic abortion of sheep, and several types of pneumonia (Endryus, 1967 and 1969) All of these agents resemble each other in their morphology and chemical composition, and possess genetic antigens

Data on *Chlamydia* in farm bred, fur-bearing animals and the people working with them are not available in literature However, according to the reports of many investigators, infections such as ornithosis and enzootic abortion of sheep are widespread among domestic birds and small cattle in Kazakhstan According to the data given by N S Evdokimova et al (1971), on poultry farms, the average percentage of infection by the ornithosis pathogen, as determined on inner skin samples, is 11.6 in mallards and 5.3 in chicks Based on complement fixation and complement suppression tests, these values ranged from 2.2-8.3% The infection of small cattle by enzootic abortion of sheep varied from 2.6-71.6% in many regions of the Republic (Baiturina and Abisheva, 1971, Poyarkov, 1974 and others) Therefore, when studying the epizootic and epidemic status of zoonotic infections on fur farms, ornithosis and enzootic abortion of sheep are of special importance

The problem was enhanced as the feed ration of farm bred, fur-bearing animals consisted of a large proportion of meat products of small cattle, obtained from meat combines, while on some farms poultry meat was also used In this process, the epizootic status of the supplier in regard to the infection of ornithosis and enzootic abortion is not taken into consideration

In order to study the epizootic status of fur farms as regards these infections, we examined the farm workers and the farm bred fur-bearing animals using the prolonged complement fixation (RDSK) test, with the group specific ornithosis antigen supplied by the Odessa Factory of Bacterial Preparations In all, 1,279 blood serum samples of fur-bearing animals from the Alakul'sk, Zyryanovsk, and Petropavlovsk fur farms were investigated These included 539 minks, 520 silver black foxes, and 220 blue foxes The complement binding antibodies in the titers 1:8 to 1:128 were identified

in 11 to 66% of the cases. The highest infection of animals was 58% on the Zyryanovsk fur farm, it was much lower, 17%, on the Alakul'sk farm and 11% on the Petropavlovsk farm. Minks were more susceptible than the other species of animals covered in the test. Thus, on the Alakul'sk fur farm, the infection in minks was 24% and in silver-black foxes 0.7%, on the Zyryanovsk farm, in minks 66% and in blue foxes 52%. In our studies, the infection level in the juvenile and adult animals was roughly the same.

In investigations of 192 blood serum samples of breeders on these farms, the complement fixative antibodies against ornithosis antigen were established in four men, or 2.08% of those surveyed.

In order to determine the reasons for the high incidence of ornithosis among the fur-bearing animals on the Zyryanovsk farm, the records of meat products received and used on the farm were analyzed. This revealed that, apart from the meat products coming from the meat combines, the Zyryanovsk fur farm was receiving salvaged birds, i.e., chicken and mallards, from a local poultry farm. Like meat products, poultry meat did not undergo thermal treatment.

According to the data of A. D. Tkachenko and N. S. Evdokimova (1972), the infection of mallards and chickens on poultry farms in the Zyryanovsk region was 84% and the incidence of infection among the working personnel 19.5%. Thus, ornithosis came onto the Zyryanovsk fur farm through salvaged birds from the local poultry farms.

Taking into consideration the significant infection of small cattle by pathogens of enzootic abortion, the possibility of transmitting this infection through meat products to the other fur farms in the Republic should not be overlooked. The common antigen nature of the pathogens of *Citlamydiae*, however, does not permit their serological differentiation.

In the interest of the future development of farm breeding of fur-bearing animals, directors and specialists should plan intense veterinary-sanitary supervision and improved medical facilities on these specialized fur farms.

Q-FEVER ON FUR FARMS IN KAZAKHSTAN

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Many investigators have noted the importance of meat products as a source of certain infectious diseases (brucellosis, tuberculosis, toxoplasmosis, and leptospirosis) in farm-bred, fur-bearing animals (Lyubashenko, 1952, Khaikin, 1965, Rementsova, Postricheva and Rybalko, 1969 and Nikulina 1972). There is, however, no information in regard to Q fever.

Taking into consideration the high incidence of Q-fever among large and small cattle (13-33.0% and 4.8-24.1%, respectively), in the northern and southern regions of Kazakhstan (Makhmetov, 1959, Sukhodoeva, 1963, Kireev, 1964, and Amanzhulov, Postricheva et al., 1964), we carried out investigations regarding the incidence of Q fever on fur farms. The reaction of prolonged complement fixation (RDSK) was used in the investigations (Zdrodovskii and Golinevich, 1965).

In all, 10 farms of the Kazakhstan Fur Cooperative system, located in the north- and southeastern regions, were covered. Studies of 5,233 blood serum samples from four species of animals (mink, blue fox, silver-black fox, and coypu) established that Q fever was quite widespread in animals when meat products of different domestic and wild (saiga) animals were included in the feed ration. Thus, among minks, the proportion of positively responding animals averaged 6.1% out of 1,317 studied, silver-black foxes 4.6% out of a total of 1,803 animals and blue foxes 4.5% out of a total of 855 animals. Further, the incidence was nearly the same in the south- and northeastern regions. The infection in adult females discarded for reasons of abortions, sterility and other pathological conditions was 1.5 to 2 times greater (3.4 to 9.0%) than in juveniles (2.1 to 6.0%).

Studies of 1,263 blood serum samples of farm-bred coypus, whose ration was mainly of plant origin, did not reveal specific antibodies to the antigens of Bernet's fever. The high incidence of infection in farm-bred minks, blue and silver black foxes should be regarded as a result of their feeding on raw meat and meat products of farm and wild animals infected by Q fever.

Our investigations of farm animals on the Alma Ata meat combine revealed the presence of complement binding antibodies to Bernet's fever antigen in 13.3% of the large cattle and 4.4% of the small cattle. Studies of the blood serum of the workers serving on these farms using the RDSK, established the incidence of Q fever in 7.6-18.0% of them.

The high tolerance of the Q fever pathogen to environmental conditions

plays an important role in the epidemiology and epizootology of this disease on fur farms. Thus, according to Soviet investigators, the causative organisms of Bernet's fever remained active for 30 days in meat stored at $+4^{\circ}\text{C}$, for 150 days in a 10% NaCl solution at $+4$ to 8°C , for 45 days in frozen carcasses, and up to 125 days in whole milk stored in the refrigerator.

It is quite possible that the severe diseases with relapses suffered by the breeders could be Q-fever, which was not diagnosed in time. Losses suffered by the farms in the Republic due to sterility, abortions among strain stock and the death of juveniles are to a certain extent due to Q-fever

Keeping in mind the future welfare of fur-breeding in Kazakhstan, attempts should be made to determine more effective methods for controlling this infectious disease

STUDY OF THE CANINE DISTEMPER VIRUS IN A CULTURE OF HEPATIC CELLS OF GREEN MARMOSETS AND IN SEROLOGICAL REACTIONS

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1 *Patch formation* A homogenate of the spleen from minks which had died of canine distemper was used as the virus source. After five passages in an intimate culture of the kidney cells of green marmosets, a marked cytopathogenic effect with destruction of the monolayer was detected 5 to 7 days after infection of the three day layer washed from the nutrient medium. In earlier periods, the cytopathological effect was seen in the formation of foci of syncytium and giant cells.

When using the patch method for a quantitative determination of the intensity of infection of the transient virus, the titer went up to 5×10^5 BOE (patch formation units) per ml. Patches were noticed 6 to 11 days after infection by the culture and they had a distinct appearance. The appearance of patches depended to a significant extent on the quality and age of the cell bed and also on the composition of the agar coating. The optimal compositions of the coating in our experiments were as follows (in 100 ml): thrice-distilled water 36, 10 fold Earl solution 20, 7.5% NaHCO_3 solution 7, neutral red 1, 10,000 μ , ecmolin 10, aminopeptide 8, and fat-free milk 15 ml. An equal volume of a 2% solution of Difco agar was added to this mixture.

After infection by dried virus (Rockborn strain), as well as by a suspension of the infected organs of animals without preliminary treatment, patch formation was not noticed, evidently because of the low virus concentration. In low dilutions the highly active transient virus caused lysis of the cellular monolayer within the first few days after infection, the presence of the virus could be judged from patch formation in very high dilutions. The possibility of using patch formation as a virus neutralizing reaction, by the method of reducing the number of patches is being investigated.

2 *Cytopathological action of the virus in a tissue culture* To test the extent of infection of the virus culture cytopathologically, titration of the virus in a monolayer of cells was carried out in insulinic flasks of neutral glass, which had a capacity of 5 ml. The best quality 2- to 3 day monolayer cultures were obtained by seeding at the bottom of flasks, which ensured high sensitivity of the cells to the virus and improvement of the results. The volume

of the culture medium was 1 ml, and it was replaced 4-6 days after infection, the final results were computed after 10 days. The composition of the medium was Hank's solution with 0.5% lactalbumin hydrolysate, 50%, Earl's solution with 0.5% lactalbumin hydrolysate, 25%, and Igol's medium with glutamine, 25%. Serum proportion 10% on seeding and 2% after infection.

3 In order to obtain diagnostic serums by hyperimmunization of sick or vaccinated blue foxes, the highly pathogenic Gauyazskii strain was used on blue foxes. The resultant immune serums were used in neutralization reactions in cultures of hepatic cells from green marmosets (KPZM), using the cytopathogenic method. These showed a virus neutralizing antibody titer of not less than 1:128 (at a virus dosage of 300 TsPD₅₀). The serum has been recommended for production control of the Vakchum vaccine and for differentiating the strains by the kinetic neutralization reaction and also by McBraid and Vecker's method.

4 The wild field virus of canine distemper, after adaptation to a KPZM culture with an infection titer of 1×10^5 to 5×10^5 TsPD₅₀ per ml, did not cause visible distemper on intramuscular inoculation to adult foxes. Experiments on the selection and adaption to tissue cultures of the distemper virus from the organs of dead animals in the epizootic regions continue to obtain a stable virulent culture strain, pathogenic to the fur-bearing animals.

5 Investigations are being carried out to determine the antigen activity in different varieties of virus grown under conditions that ensure maximum accumulation followed by purification, concentration (polyethylene glycol with a molecular weight of 4,000), and dialysis. The development of a method for optimum purification aims at producing an antigen to diagnose distemper and to produce a control vaccine for immunity.

PATHOANATOMICAL CHANGES IN THE STOMACH AND INTESTINES OF MINKS SUFFERING FROM GASTROENTERITIS

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Material collected from 28 dead adult minks was investigated. Bits of the gastro-intestinal wall were fixed in Carnoy's solution and 10% neutral formalin. Sections were stained by the usual methods and also by the method of Shabadash and Brash. The author's own observations on the normal histology of the tissue of the stomach and intestines in minks were used as controls (Sadovnikova, 1973).

Inflammatory processes were detected in the stomach and in the proximal region of the small intestine. In actual catarrhal inflammation, the mucosa was swollen and fairly unevenly stained, and it was covered with a viscous light gray or brownish red abundant mass. On microscopic investigation, a thick layer of neutral mucopolysaccharides was seen on the surface of the stomach mucosa, especially in the pyloric region. These were unevenly distributed in the cells of the surface epithelium. In some sections, the surface and pitted epithelium were desquamated. The staining property of the cytoplasm of cover cells ranged from faintly visible to very intense. The RNA content in the main cells was insignificant. The nucleus in many mucosa cells and in the pyloric gland cells was in a pyknotic state.

The epithelium covering some sections of intestinal villi was desquamated. There was an increase in the number of goblet cells, especially in the crypts. These cells were enlarged and filled with neutral mucopolysaccharides.

The stroma proper and the submucosa of the stomach and intestine were somewhat edematous and contained a moderate amount of polymorphocellular infiltrate. Blood vessels were significantly filled with blood. In some minks, at the level of the gastric pits in certain places, the stroma was filled with erythrocytes.

Chronic inflammatory processes could not be detected on macroscopic examination of the mucosa. The vascular-inflammatory reaction was weak. Lymphoid cells predominated in the infiltrate. The epithelium on the surface and on the gastric pits of the stomach was not always intact. In the stomach and also in the secretory pyloric and duodenal regions, the content of neutral mucopolysaccharides decreased. The presence of neutral mucopolysaccharides was not rare in the main cells. Sections with a thinned

layer and without the principal cover and accessory cells were found, while the gastric pits were deepened almost to the muscular layer. Sometimes the glandular elements were atrophied as a result of the enlargement of connective tissue.

Some intestinal villi in the proximal portion had no epithelium. In many sections the brush border showed that the neutral mucopolysaccharide zone had thinned. In the goblet cells, their number varied from significant to minimal. The nucleus of some cells was in a state of pyknosis.

No clinical symptoms of the inflammatory process can be seen in the *mucosa of the stomach or in the proximal region of the small intestine*, when circulatory disturbances, combined with dystrophic and necrobiotic changes, are moderate or weak.

TOXOPLASMOSIS IN FARM-BRED FUR-BEARING ANIMALS

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Sterility, abortion, and premature death of juveniles often occur in farm-bred blue foxes, minks, and silver-black foxes. Infectious and invasive diseases, including toxoplasmosis, could be responsible for these conditions.

Very little information is available in literature on toxoplasmosis in fur bearing animals. Toxoplasmosis was first reported in minks (Hulland, 1956). Subsequently, the positive complement fixation reaction (RSK) to this infection was recorded in blue foxes, minks, and silver-black foxes (Levit and Vastina, 1963, Levit et al., 1965, Novinskaya, 1963, and Sukovtova, 1972). In some cases, the number of animals responding positively to toxoplasmosis was fairly high: among blue foxes 40.9%, minks 33.5%, and silver black foxes 53.2%.

Our investigations on toxoplasmosis in blue foxes, American minks, and silver-black and red foxes were carried out on two farms. In all, 36 American minks and 57 blue foxes were investigated in the Novosibirsk region (Barabinsk Fur Cooperative), while 50 blue foxes and one red fox were investigated in the Tuva Autonomous Soviet Socialist Republic (Bureinsk state farm). The RSK of the blood serum, using KazNIVI (Kazansk Veterinary Institute) antibodies, was studied in the Laboratory of Toxoplasmosis of the Institute of Zoology, Academy of Sciences, Kazakhs Soviet Socialist Republic. All of the blood serum samples gave negative RSK results.

Smears were prepared from the liver, spleen, brain and lungs of 151 animals (Barabinsk Cooperative Fur Farm). Smears were also prepared from females which did not whelp or which aborted, and from weak animals with indistinct clinical symptoms. In smears stained by the Romanovski-Giemsa method, *Toxoplasma* was detected in the form of cysts and trophozoites. Parasites were found in silver-black foxes, blue foxes, and American minks. Simultaneously, on the farms of the Barabinsk Fur Cooperative, nine brown rats and 11 magpies were caught and investigated for toxoplasmosis. Toxoplasmosis antibodies were found in one rat and two magpies.

On the Bureinsk state farm, a Daurian pika caught on the farm and a common fox caught in its vicinity were investigated. They gave negative results for toxoplasmosis. The farms were fenced, thus preventing the influx of cats and dogs into the territory. Private and community cattle were not allowed to graze near the farm territory.

Data available in literature and our own investigations confirm the prevalence of toxoplasmosis under the conditions on these fur farms and stress the need for systematic studies on this infection in farm-bred animals.

PREPARATION AND TESTING OF SEMILIQUID FORMOL-ALUMINUM HYDROXIDE VACCINES AGAINST PASTEURELLOSIS IN COYPU

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Four series of semiliquid formol aluminum hydroxide vaccines were prepared from local strains of coypu *Pasteurella*, in accordance with the instructions given by the AzNIVI for the production and control of anti-pasteurellosis vaccine for large cattle and buffaloes. These instructions were approved by the Central Board of Veterinary Sciences, Ministry of Agriculture, USSR, on December 24, 1968.

Each of the vaccines contained 10% aluminum hydroxide and 0.26% formalin, but they differed in their content of *Pasteurella* strains. Each series was tested for sterility, nontoxicity, and activity level. All the vaccines were found to be equally active and provided stable immunity to the inoculated animals by the 12th day after vaccination. Experiments were carried out on coypus to ascertain the dosage and number of inoculations, effectiveness of the method of administration, period of onset of immunity, and its intensity. It was established that, after two intramuscular inoculations of semiliquid formol-aluminum hydroxide (1 and 2 ml) at an interval of 12 days, immunity set in on the 12th day after vaccination. Moreover, after controlled infection, the vaccinated animals withstood 10 fatal doses of virulent *Pasteurella* strains.

On the second day, the site of the injection in the vaccinated coypus revealed slight edema and the body temperature rose by 0.2 to 0.8°, there was depression and lack of appetite in some animals. These symptoms disappeared within two or three days after the inoculation. The nontoxicity of the vaccine was confirmed and subsequently it was put to extensive use.

On a farm with unfavorable conditions for rearing coypus, 1,492 animals were vaccinated against pasteurellosis. Fourteen days after the second vaccination, some of the immunized animals (20) were subjected to controlled infection and the controls (five animals) were infected with virulent strains of coypu pasteurellosis. The control animals died 24-48 hrs after the infection, while none of the immunized coypus died during the 15 days of observation. The vaccination had no effect on the growth of the coypus or their pelt quality.

The duration and intensity of postvaccination immunity was studied in an experimental test. Some 25-4 days after vaccination, all of the experimental coypus withstood infection by epizootic pasteurellosis strains, while the controls perished.

Based on these results, it can be concluded that field injections with semiliquid formol-aluminum hydroxide vaccine against pasteurellosis provide coypus with immunity for over eight months (period of observation) and can be used for specific prophylaxis against pasteurellosis in coypus susceptible to this disease.

COMPARATIVE STUDY OF THE PHYSICAL AND CHEMICAL PROPERTIES OF VACCINE STRAINS OF CANINE DISTEMPER VIRUS

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The canine distemper virus (VChP) of the KF-668 strain was grown in a culture of chicken embryo cells and that of the EPM strain was grown in a culture of Japanese quail cells. The number of inoculations was 1 to 2 TtD_{50} per cell. The virus was tagged with N^3 -uridine at 5μ curies/ml.

The tagged VChP was concentrated to one-thousandth of its volume by differential centrifuging and centrifuging in a saccharose density gradient. On equilibrium centrifuging of the two strains of VChP, the radioactivity was distributed in the density ranges 1.15 g/ml for the KF-668 strain and 1.19 g/ml for the EPM strain. Radioactive peaks were closely correlated with the distribution of infection intensity and optical density (260 nm). The sedimentation constant of VChP was 80 S.

After treatment with the non ionic detergent NP-40 in a 0.5% end concentration, viral structures were detected which had a floating density of 1.25 g/ml for the KF-668 strain and 1.30 g/ml for the strain EPM representing nucleoides.

Purified and concentrated VChP was studied in a polyacrylamide gel (PAAG). Protein electrophoresis was done in a 5% PAAG with 0.1% sodium dodecyl sulfate.

To determine the molecular weight, simultaneous electrophoresis was carried out on test samples and on tagged proteins of known molecular weight. The tagged proteins used were phosphorylase A (mol wt 95,000), serum albumin (68,000), ovalbumin (45,000), ribonuclease (14,000) and lysozyme (12,000).

The results of experiments carried out in PAAG showed some discrepancies in the molecular weights of the virus-specific proteins found in the strains under study.

LABORATORY CULTURES OF AUJESZKY'S DISEASE VIRUS USED TO PREPARE INACTIVE VACCINES

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In this work the Aujeszky's disease virus (VBA) of strain "P", adapted to a culture of chick embryo cells (20 to 30 passages) was used. The sensitivity of cell cultures on different pig tissues was determined: kidney, spleen, lungs, brain, leukocytes, and chick embryo cells. The virus was grown in cell suspensions inside revolving bottles. A cell suspension (2-4 million/ml) in a GLA (glucose agar) medium with 5% cattle serum, pH 7.4-7.6, was inoculated with the virus (10^5 to $10^{5.5}$ TTsD₅₀/ml) and incubated for 42 to 48 hr. The resultant virus suspension was used to make the inactivated vaccine. Inactivation was done by copper sulfate (5 millimolars, mM, 37°, six days). To improve the immunogenic properties of the vaccine, the virus was concentrated to one-half (by volume) on aluminum hydroxide (6% dry residue). At the end of inactivation, saponin at a concentration of 0.5 mg/ml was added to the vaccine. The immunity of inactivated preparations was determined in rabbits by two intramuscular injections of 5 ml each.

A good accumulation of VBA was noticed in the chicken embryo and kidney cell suspensions ($10^{7.45}$ to $10^{7.71}$ TTsD₅₀/ml). In the suspension of lung cells, the virus titer was $10^{6.35}$ TTsD₅₀/ml and in brain cells $10^{5.1}$ TTsD₅₀/ml. The virus reproduced in these cultures after it was passed in a series. The virus did not proliferate in the spleen cells or leukocytes. On the addition of chicken embryo cells (1.0 to 1.5 million/ml) to permissible or weakly sensitive cultures (spleen, lung, brain and leukocyte cells), the titer of the virus in a suspension of mixed cultures increased significantly (by 1 to 21 10^6 TTsD₅₀/ml).

The inactivated vaccines made from the virus grown in chicken embryo, kidney, and lung cell suspensions protected 80-86% of the vaccinated rabbits against controlled infection with an epizootic virus (50 to 200 TTsD₅₀/ml). The vaccines obtained from the virus grown in mixed cell cultures (spleen + chicken embryo, leukocytes + chicken embryo, and kidney + chicken embryo cells) offered a higher immunity (80-100% protection).

The results of these experiments showed that the VBA reproduces in many cell cultures. The inactivated vaccine prepared by above method exhibited good immunogenic properties in tests on rabbits. In mixed cultures, the virus titer rose significantly and the vaccine quality improved.

IMMUNOLOGICAL PROPERTIES OF INACTIVATED VACCINES AGAINST AUJESZKY'S DISEASE IN FUR-BEARING ANIMALS

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The Aujeszky's disease virus (VBA) of strain "P" was grown in a suspension of chicken embryo cells (0.25 to 4 million cells/ml) in a GLA (glucose agar) medium with 5% cattle serum inside revolving vessels for 42 to 48 hr. The resultant viral suspension was inactivated with copper sulfate (5 mM, 37°, 6 days). The inactivated suspension was used to make different samples of vaccine: aluminum hydroxide (GOA)-saponin, emulsified, and dry. For the first two varieties, the adjuvants GOA and saponin or mineral oil with lanolin were added. For the dry vaccine, the solvent containing the GOA and saponin adjuvants was prepared individually.

The VBA accumulated in the titers $10^{7.4}$ to $10^{7.7}$ TTsD₅₀/ml in a suspension containing 2-4 million cells per ml. On reducing the cell density in the suspension to 0.25-0.5 million/ml, the virus accumulation decreased ($10^{6.5}$ TTsD₅₀/ml). The inactivated GOA-saponin vaccines prepared from these viral suspensions showed varying immunogenic levels in tests on rabbits. The greater the concentration of cells in the suspension used for growing the virus, the higher was the immunogenic property of the vaccine. At a cell density of 3 to 4 million/ml, the vaccine protected 83-85% of the animals and at 2-2.5 million cells/ml, 70-78% were protected, a density of 0.5 million cells/ml offered no immunogenic property.

A vaccine dose of 2-5 ml administered twice to rabbits did not result in any difference in the intensity of immunity in the immunized animals.

Tests with GOA-saponin vaccine on adult minks showed 70-95% protection after a single inoculation and 90-100% protection after two inoculations. The vaccinated minks remained resistant to Aujeszky's disease for two months. After 1.5 months, the immunity weakened (25% protection). A single booster dose during this period provided stable immunity in the vaccinated minks for periods of up to three months.

Two inoculations of emulsified or dry vaccines afforded minks 100% protection. However, it should be pointed out that the dry vaccine rapidly lost its immunogenic properties.

Field tests on the Odessa fur farm, using GOA-saponin vaccine produced by the Stavropol'sk Biological Factory, established that the immunity of the

animals weakened after three months. With an outbreak of Aujeszky's disease on the farm, death occurred in 1.8% of the vaccinated minks, while 7.5% of those in the control group died.

Thus, the results of these investigations showed that the inactivated vaccine against Aujeszky's disease can be successfully used for the vaccination of fur-bearing animals.

PROBLEMS FACING VETERINARY SPECIALISTS ON KAZAKHSTAN FUR FARMS

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The Board of the Kazakh Fur Cooperative was organized in 1968, by the consumer unions in the Republic. The Kazakhstan consumer cooperatives now consist of nine fur farms, including three regional consumer unions. At present the Kazakhstan farms have 5,600 silver black foxes, 3,370 blue foxes and 11,440 minks in the main herds. Coypus are reared on the Chuisk farm in Dzhambul'sk.

Along with technical equipment and increased refrigeration capacity, more specialists are being provided for the farms. As a result, the quality of veterinary prophylactic and therapeutic services has visibly improved on these farms. However, there has not yet been any significant decrease in the wastage of animals due to different diseases. The veterinary sanitary practices on the farms are still not up to the mark. The majority of specialists do not show adequate initiative in taking timely and constructive decisions. The Kazakh Fur Cooperative arranges conferences with zoological and veterinary specialists at least once a year, and the technical staff engaged in fur farming take part in these. Disinfecting equipment is necessary for proper disinfection of fur farms but it is not possible to acquire this equipment from the zoological and veterinary suppliers. There are great difficulties in freezing and grading pig products. Therefore, there is an urgent need for an effective vaccine against Aujeszky's disease.

The pioneer work of scientists from the All Union Research Institute of Game Management and Fur Farming and the All Union Research Institute of Fur Farming in developing a method for simultaneous vaccination of minks against distemper and botulism, should be commended.

Our fur farms are usually located close to regional centers and at the first instance of the death of an animal, the pathological material is sent to the regional veterinary laboratory. These laboratories are often not in a position to make accurate diagnosis of the disease and thus the period of investigation is prolonged. The veterinary laboratory of the Republic specializes in diseases of fur bearing animals, but the method for investigating the pathological material of canine distemper has not yet been thoroughly worked out. Fur farms need qualified assistance to ensure prophylactic and therapeutic measures against diseases such as self-biting, tuberculosis, plasmocytosis, urolithiasis, and hepatic dystrophy. It is not always possible to carry out this work in time on all the fur farms.

RESULTS OF FIELD TESTS ON THE METHOD OF SPECIFIC DIAGNOSIS OF ALEUTIAN DISEASE IN MINKS

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The specific reaction of immunoelectroosmophoresis (RIEOF) is now being developed and tested for diagnosing Aleutian disease in minks. In our previous experiments, when an indigenously produced antigen was used in RIEOF (Slugin and Chebotarev), as in the experiments of foreign scientists, this reaction showed significant advantages over the usual nonspecific iodine agglutination test (IAT). This work presents the results of field tests on RIEOF carried out in January and February 1977, on four state fur farms which differed in the incidence of Aleutian disease in the mink herd and in geographic location. In accordance with the prevailing norms, two of the farms were regarded as resistant to Aleutian disease (less than 5% of the minks reacted positively to the IAT) while the two others were regarded as susceptible (on one farm the IAT in the previous season had been positive in 14.2% of the minks and on another in 35.0% of the minks).

Investigations using RIEOF and IAT were simultaneously carried out on 21,087 minks of different colors. On the resistant farms RIEOF was positive in 8.8 and 11.8% (positive IAT in 1.4%) of the minks tested while the corresponding values on the susceptible farms were 47.1 and 72.0% (about 20% of the minks reacted positively to the IAT). On the immune as well as the susceptible farms, the incidence determined by the RIEOF varied significantly in different brigades and divisions. On the susceptible farms divisions with a high incidence (up to 93.6%) and with an unusually low IAT (1.1 and 4.3%) were identified. Further, the divisions with low infection were supplemented with animals brought from the farms immune to Aleutian disease.

On the immune farms, also, the incidence of infection varied widely. In some brigades it was comparatively high (about 18%) and in others low (0.2%). In different divisions of these brigades, the variations were even more significant, from nil to 17.5%. A positive IAT in most cases was confirmed by the RIEOF of the minks in susceptible brigades and divisions but false negative results from IAT were high. In the resistant brigades and divisions, a reverse pattern was noticed.

A study of the results of IAT carried out in the preceding years or months reveals a distinct pattern. RIEOF is often positive in brigades (divisions) in which there is a high percentage of minks positive to IAT.

These investigations point out that RIEOF is superior to IAT in sensitivity. It is positive predominantly among minks in divisions and brigades which are susceptible to Aleutian disease on the basis of clinical and epizootological data and IAT results spanning several months or years.

The RIEOF may be used successfully for large-scale specific diagnosis directly on the farms.

LIVER PROTEINS IN NORMAL AND DIPHYLLOBOTHRIASIS AFFECTED FARM BRED BLUE FOXES

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It is known that during diphyllobothriasis, blue foxes suffer from serious disturbances such as anemia along with B₁₂ avitaminosis and serum hyperalphaglobulinemia. These result from infections in the liver, etc., leading to impairment of the commercial quality of the pelt and thereby inflicting heavy economic losses (Berestov, 1971).

The purpose of the present work is to study the effect of invasion by broad tapeworm on the qualitative and quantitative composition of the cytoplasmic proteins in the liver of blue foxes.

Material for the study was collected in October and November 1976, during the slaughtering of blue foxes at the experimental station of the Laboratory of the Physiology of Fur bearing Animals, Institute of Biology, Karelian Division, Academy of Sciences of the USSR, located on the Kondopozhsk pedigree farm.

Tris-chloride buffer (pH 7.2, 0.2 M KCl) was homogenized in a Potter-Elvehjem homogenizer and then added to a piece of liver (3-5 g) from affected foxes in a ratio of 1:1. This was centrifuged twice, once at 50,000 g (1 hr) to precipitate large cellular contents and the second at 150,000 g (1 hr) to precipitate microsomic particles and clarify the solution. The supernatant liquid containing the cytoplasmic proteins (dissolved in aqueous and saline solutions of low ionic strength) was analyzed by gel chromatography (Flodin, 1961) and disk electrophoresis in polyacrylamide gel (Davis 1964). The livers of animals free from the infection served as controls.

A mixture of water soluble proteins from the liver of infected as well as unaffected blue foxes was fractionated on Sefadex G-100 (gel chromatography) into five groups with molecular weights of 125,000 and above, 80,000 to 90,000, 60,000 to 70,000, 30,000 to 40,000 and about 20,000. The albumin-globulin coefficient (ratio of the total proteins with a molecular weight of 70,000 or less to the sum of proteins with a molecular weight of over 80,000) in the infected animals was 1.2 times more than in the unaffected ones, the protein content of the albumin fraction (60,000 to 70,000) in the infected animals was 10.8% more than in the control group. Differences were noticed in the other fractions, also.

By means of disk-electrophoresis, 21 protein bands were identified from the liver of affected blue foxes and 22 from that of the control group of animals.

Broadening by an average of five units was noticed in the band of hemoglobin in infected animals compared with the controls, and that of albumin by six units.

Thus, these results confirm that during diphyllbothriasis in blue foxes, normal hepatic function is disturbed.

ETIOLOGY OF SELF-BITING IN SABLES

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Self biting is a chronic disease seen as nervous excitement during which the sick animals bite certain sections of their own bodies. It is widely prevalent in sables and inflicts heavy economic losses. The etiology of self biting has not been understood thoroughly so far.

In order to obtain new material which could help determine its etiology and pathogenesis, and evolve control measures, we decided to experimentally induce self biting in sables. We studied the period of manifestation of clinical symptoms, duration of the disease, remission and relapse and the possibility of transmitting the disease from sick to healthy sables.

Self biting was induced without the use of any virus or any other microbiological agent by placing the weaned sable kits in cages, not in two's but singly. Investigations were carried out on the principle of total analogues.

As a result of the experiments, the disease was successfully induced in 134 out of 161 kits (83.2%) held singly. In 419 kits held two or three in a cage (up to August 1), only 11 animals (2.6%) showed skin damage somewhat akin to self biting.

The symptoms of self biting were seen within 10 days after weaning from the mother, mainly within the first two months. Sometimes self biting lasted, without interruption, for over 40 months (period of observation), but more often there were remissions, which in some animals were as many as four in the above period. Remissions continued for 18.5 months and relapses up to 10.5 months.

Attempts were made to transmit self biting from seven sick to seven healthy sables by allowing them to remain together, by exchanging the objects used, by giving the food and water remnants of sick ones to healthy ones for a prolonged period (right up to 40 months) and also by allowing direct contact with the sick animals. These did not induce the disease.

Inoculating 33 healthy animals (fully mature and juvenile) with pathological material drawn from sick sables did not induce the disease even in a single case in 2-12 months (period of observation).

The skin damage in killed sick sables was studied by our method and classified into five types. In the majority of sick sables (85.2%), skin damage characteristic of the first and second types of self biting was seen as skin perforations or intense black spots of different sizes and localizations.

Thus, one of the main causes for this disease in sable kits is a nervous disturbance caused by their living singly in cages immediately after weaning.

from their mothers. Our experiments did not confirm that the disease was infectious.

In sables suffering from self-biting, macroscopic changes were noticed on the skin. These were of definite value for postmortem diagnosis.

ROLE OF *ESCHERICHIA COLI* IN THE MORTALITY OF NEWBORN KITTENS OF FUR-BEARING ANIMALS

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The death of newborn kittens of fur bearing animals within the first few days of their birth is common on all the fur farms. In practice, the so-called "pre registration" death of kits, to the extent of 10% of total births, is regarded as a normal phenomenon. It is not rare to find the wastage of newborn kits going up to 25-30% or more. In studying the reasons for the death of kits, attention so far has been mainly devoted to the zootechnical and purely farm aspects and very little to the study of the role of known or suspected pathogens. The literature available on this subject (Omel'chenko, 1955 and Slugin, 1969) points out that, on some farms, coli infection is a factor in the high mortality of kittens during the first few days after birth.

From 1971 through 1976, bacteriological investigations were carried out on 950 carcasses of kits which had died in the first few days after birth, of stillborn kits, and aborted fetuses collected from several fur farms—Vyatka VNIIOZ, Mari Regional Consumer Union, Nolinsk farm of the Kirov Regional Consumer Union, and the Bobruisk Squirrel Fur Farm. Carcasses of 217 kits of silver black foxes, 577 blue foxes, and 156 minks were studied. Seeds from the brain, blood of the heart, liver, spleen, kidneys, lymph nodes and intestinal contents were grown on meat peptone agar and meat peptone broth, on Endo agar, and partly on Kitt-Tarocci medium. As a rule *Escherichia coli* cultures were isolated from the carcasses and, in some cases *Proteus* and nonpathogenic *Micrococcus*, *Streptococcus*, and *Staphylococcus* were also isolated. From the carcasses investigated, 841 strains of *E. coli* were isolated. Of these, 108 strains were obtained from the kittens of silver black foxes, 704 from blue foxes, and 29 from minks.

The inoculability of this bacterium was not the same on different farms. Thus, on the Vyatka fur farm, out of the carcasses tested between 1971 and 1976, it was 15-30% in the silver black fox kittens, 40-82% in blue foxes, and 7-15% in minks. On the Mari farm in the same period, it was 15-66% in blue foxes and 15% in minks. On the Bobruisk farm in 1975, it was 53% of the carcasses investigated and on the Nolinsk farm 45-4%.

Hemolytic properties were exhibited by 27.9% of the isolated strains of *E. coli*. The highest level of hemolysis was observed in the cultures obtained from the organs, blood of the heart and brain, and simultaneously from the organs and intestine. About a quarter of the strains caused fermentation of

saccharose The toxicity of *E. coli* was studied on white mice through intraperitoneal administration of centrifugates of daily broth cultures at 0.2-0.5 ml. Ninety-two percent of the isolated cultures were found to be toxic. All of the mice died 18-24 hr after infection, with symptoms of damage to the nervous system. About 90.7% of the strains were found to be pathogenic to white mice on intraperitoneal injection of 500 million microorganisms of the wash from the daily agar culture.

The toxic hemolytic strains exhibit necrotic properties on intradermal injection of centrifugates of daily broth cultures to rabbits. In the first few days after injecting 0.2 ml of culture centrifugate, widespread edema and skin hyperemia were noticed, by the end of the first day, at the site of injection, necrosis had started and the zone of necrosis gradually enlarged, measuring 18-22 mm in diameter by the fifth day.

The *E. coli* cultures isolated by us were found to be most sensitive to neomycin, chloromycetin, and monomycin, while half of the cultures were sensitive to streptomycin. All the strains were insensitive to penicillin and chlorotetracycline.

These investigations confirm that *E. coli* is one of the etiological factors in the death of newborn kittens of fur-bearing animals.

INNOCUITY AND IMMUNOGENICITY OF THE "AUF" STRAIN OF ANTILISTEROSIS VACCINE IN MINKS

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Listeriosis occurs frequently in fur-bearing animals, and hence the development of a specific prophylaxis against this disease is an important problem facing breeders. The object of the present investigation is to test the innocuity and determine the immunological effectiveness for minks of antilisterosis vaccines based on the "AUF" strain, as suggested by Prof. A V Selvanov for farm animals.

To determine the innocuity of the vaccine, 60 animals were used. These were divided into six groups of 10 animals each. The first group was given 0.5 billion microorganisms, the second group one billion, the third group two billion, the fourth group four billion, the fifth group eight billion, and the sixth group 16 billion microorganisms of "AUF" strain vaccine. The vaccine was administered intramuscularly on the inner femoral surface. All the animals remained active for 14 days (period of observation) and did not exhibit any abnormalities.

In order to test the immunological effectiveness of the vaccine on fur farms susceptible to listeriosis, 300 female minks from the main herd were inoculated before the estrous cycle. The vaccine was administered in a dose of two billion microorganisms intramuscularly. The antilisterosis measures worked out by us were implemented on the fur farm, and this resulted in a great reduction in the number of females remaining sterile and in the level of wastage of gestating females and newborn kittens. As a result the yield of kits increased. The effectiveness of the vaccination was judged from the productive indices, which were a result of antilisterosis measures. All of the indices were significantly higher in the experimental group: the yield of kittens per female in this group was 4.6 against 4.2 for the farm as a whole. Before carrying out these measures, the yield of kittens had been 3.0-3.6 and the females remaining sterile had been almost four times greater at 27-32.4% against 8.4% after eradication of listeriosis.

Immunological efficiency was also studied by controlled infection of the unimmunized minks. In the experiments three groups of minks, with five in each group, were used. One group was given vaccine at 2.5 billion microorganisms and another at five billion microorganisms while the third group served as the control. Before vaccination, three minks from each group were irradiated with X-rays at a dosage of 150 roentgens. Fifteen days after vaccina-

tion, a fatal dose of *Listeria* was given subcutaneously to the minks of all three groups. From those in the control group that had been irradiated, one died on the fourth day and one on the fifth day. The vaccinated animals of the first and second groups and three minks from the third group, including one that had been irradiated remained active for 30 days (period of observation) without showing any abnormalities.

By bacteriological seeding, pure cultures of *Listeria* were isolated from the internal organs and brain of the dead minks. *Listeria* were not isolated from the carcasses of killed animals of the first and second groups.

From these experiments it can be concluded that the "AUF" strain of vaccine is nontoxic to minks, possesses immunogenic properties, and may be recommended for specific prophylaxis against listeriosis for this species.

PATHOMORPHOLOGICAL CHANGES IN COYPUS DURING PASTEURELLOSIS

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Pasteurellosis in coypus is a little-known disease. On one of the fur farms under observation, the disease broke out in an acute form as croupous-purulent pneumonia and became widespread. As a result 1,480 animals died on that farm.

An autopsy of the dead animals showed accumulations of sero-fibrinous or purulent-fibrinous exudate and fibrin films on the costal and thoracic pleurae in the thoracic cavity. The pericardium fused with the myocardium. The heart was dark red in color, its muscles became flabby, and pitted, banded hemorrhages were seen on the myocardium and endocardium. The lungs were edematous with portions showing different degrees of hepatization. Large diffused hemorrhages were seen on the surface, and in the cross section of bronchi there were innumerable tiny necrotic foci, and a yellow body containing purulent matter. A red foamy liquid was found in the trachea, its mucous membrane became hyperemic, banded hemorrhages were seen in the mucosa of the larynx. Bronchial lymphatic nodes became enlarged and succulent in the cross section. The liver was filled with blood, enlarged and slightly lacerated, and on the surface there were innumerable hemorrhages and tiny necrotic foci. In most cases the gallbladder was empty. The spleen was greatly enlarged, dark cherry-red in color and covered with innumerable hemorrhages, its transverse section was almost circular. The kidneys were spotted with hemorrhages of different forms and necrotic foci, in the thin section, the structure of the kidney was smooth. The adrenal glands were yellowish red, greatly enlarged, and distended lengthwise. The mucous gullet was hyperemic, the stomach was empty, its pyloric portion had hemorrhages, and erosions were often seen in the mucous portion. Hemorrhages could be seen in the small intestine and there was slight hyperemia in the large intestine. The gallbladder was vacant and its vessels injected.

Histological investigations established structural changes in the organs and tissues, these changes being dependent on the duration of the disease. The pulmonary alveoles were filled with a serous exudate containing a large amount of neutrophilic leukocytes, in other cases the alveoles and tiny bronchi were filled with granular and acicular precipitated fibrin, in the loops of which were seen desquamated epithelium and neutrophilic leukocytes. In the heart wall there were infiltrations of epicardium and inter-

mediary connective tissue of lymphoid and epithelial cells and stray neutrophils, in the myocardium there were wax like necroses, muscular fibers unevenly thickened, twined, and some disintegrated into fragments. Hyperemia, stasis, discomplexia of hepatic gullies, and hepatic cells in a state of granular dystrophy were seen in the liver. Hyperemia, stasis, inflammation and desquamation of endothelium of the vessels, and granular lipid dystrophy of the epithelium of tubules were seen in the kidneys. In the spleen there were hemosiderosis, hyperemia, and stasis, while the reactive centers of some follicles were smoothened. Desquamation of the epithelium and necrotic sections in the mucous membrane were found in the stomach. Deformation of the crypt and villi, desquamation of the epithelium of the villi, and infiltration of the mucous cellular elements were seen in the mucous membrane of the small intestine. In the adrenal glands there were blood circulatory disorders, enlargement of the zona fasciculata, and disturbances to the radial placement of the pyramid of the zona fasciculata. The stroma in the thyroid gland was thickened and profusely infiltrated by cellular elements.

VIRULENT PROPERTIES OF THE SNAUDER HILL STRAIN OF CANINE DISTEMPER VIRUS

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Investigations were carried out on the virulent canine distemper virus (Snauder Hill strain), kindly supplied by Director Makovyak of the Institute of Foot and Mouth Diseases and his deputy Zhulber (France). This strain is widely used in many countries of the world (USA, Canada, Denmark, France, and others) for the control of immunity in canine distemper vaccines.

The object was to study the virulent properties of the Snauder Hill strain in minks, 'tkhorzofretkas', and blue foxes. In France, this strain is used on dogs as an intracerebral inoculation (Shapvi, Ter, et al., 1972-1974). In these experiments standard minks and some pastel minks, aged 5-18 months, tkhorzofretkas aged 4-5-6 months, and blue foxes aged 15 months were used. The starting material was a homogenate of spleen infected with canine distemper (obtained from France), which was administered intramuscularly at 1 ml to four tkhorzofretkas and nine minks. The incubation period in tkhorzofretkas lasted 9-11 days. During this period they showed reduced appetite, feed aversion, conjunctivitis, and swelling of the eyelids and extremities; in some animals, the gastro-intestinal tract was also upset.

The incubation period in minks was roughly the same as in tkhorzofretkas. Feed aversion, depression, rhinitis, and enteritis were the usual symptoms. In some animals, a nervous form of the disease, resulting in nervous breakdown, was seen.

The deaths of the animals started after 13 days and, by the 30th day, eight minks had died and one more died on the 37th day. The spleen recovered from the dead tkhorzofretkas was used to prepare the homogenate. After testing for sterility, the virus titer was determined in 'tkhorzofretkas' aged six months and minks aged 7-18 months. Four animals were used for each dilution. It was found that the virus titer for tkhorzofretkas was 10^4 LD₅₀/g of spleen and for minks 7-18 months of age $10^{4.22}$ and $10^{4.0}$ LD₅₀/g of spleen, respectively.

After inoculation of four blue foxes intramuscularly and four others subcutaneously, at 1 ml (1,000 LD₅₀) of spleen homogenate of tkhorzofretkas, no clinical symptoms of the disease were noticed for 30 days.

The results of these investigations justify the use of the Snauder Hill strain to control the immunogenicity of the vaccine against canine distemper under field conditions in tkhorzofretkas and minks.

AEROSOLS FOR PROPHYLACTIC DISINFECTION ON FUR FARMS

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With the development of fur farms, the importance of disinfection as one of the control measures for destroying pathogenic micro-organisms in the environment has increased significantly. No infectious disease can be regarded as totally eradicated until its pathogen is completely destroyed in the external environment. On fur farms, prophylactic disinfection is compulsory and is carried out before whelping of the animals and before weaning of the young.

For prophylactic disinfection, the method of "directed" aerosols, i.e., treatment of all the surfaces with a finely dispersed solution, is of great importance. This is more effective on cage surfaces and greatly reduces the consumption of the disinfectant.

Experiments were carried out on the experimental farm of the NIIPZK using a method developed by the All Union Institute of Veterinary Sanitation. *Staphylococcus* was selected as the test microbe for these experiments. The aerosol was produced in the aerosol aggregates AG UD-2 and ADK-1000 designed on the experimental farm of the NIIPZK.

It was established that a dependable disinfection of fur farm objects was possible by using the following materials:

- 1 7% solution of formalin at 150 ml/m³,
- 2 5% solution of hydrogen peroxide activated with 1% acetic acid at 150 ml/m³,
- 3 hypochlorite solution containing 2% active chlorine at 150 ml/m³,
4 0.5% solution of trichloroisocyanuric acid at 200 ml/m³.

The exposure time in all cases was one hour. Tests were carried out in the temperature range +5 to +25° and at relative humidities of 65-90%.

PREVALENCE AND PATHOMORPHOLOGY OF TUBERCULOSIS IN MINKS

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Tuberculosis has been recorded in farm bred minks since 1932 (C Heidegger). It is encountered more frequently in these fur-bearing animals than any other bacterial disease (Villenun, 1962, Hand, 1965, Hamzova 1967, Cubinski, 1968, Mamatov, 1966 and Kuznetsova, 1968).

Minks can be infected by all three types of tubercular bacteria (L Ionber, 1959, R E Hall and F Winkel, 1957, Turkebaeva and Krivtsova, 1975, Kuznetsova, 1968, Mamatov, 1966, L Cerny, 1963, Akulova 1969, Danilov, 1964, and Adamesteanu et al, 1970).

According to veterinary records, in the Leningrad region in 1967, a tuberculosis susceptible site was identified with 25 affected minks, in 1968, there were three sites with 24 affected minks, and in 1969 one susceptible site had 302 minks suffering from tuberculosis.

Information on the prevalence of tuberculosis in minks over a six year period (1969 through 1974) on one state fur farm is given in Table 1.

Table 1 Prevalence of tuberculosis in minks

Year	Number of dead minks	Percentage of total deaths in the year
1969	11	0.8
1970	5	0.3
1971	221	10.3
1972	56	3.6
1973	51	13.0
1974	23	6.4

The diagnosis of tuberculosis was confirmed by bacteriological tests and the *Mycobacterium tuberculosis* typ. *bovis* culture was isolated.

The disease was mainly found in pastel minks.

Tuberculous changes were found in different organs and systems (generalized tuberculosis), in almost all cases, the mesenteric lymph nodes or intestines were infected. Tubercles represented the main form of tuberculosis.

In the lungs, spleen, kidneys, liver, intestinal wall, and mesenteric lymph nodes, small productive nodules were found. In some cases, caseous discoloration

tion with petrification was noticed. Further, hyperplasia of the spleen, fatty and granular dystrophy, and venous congestion of the liver were seen.

The following conclusions can be drawn on the basis of these investigations:

1. Minks contact tuberculosis mostly through the alimentary canal, due to the intake of infected food products.
2. Tuberculosis in minks caused by *Myc. tubercul. bovinus* is chronic and often assumes a generalized character.
3. The primary tuberculous process proceeds in the manner of an incomplete complex.
4. Tuberculous nodules consist mainly of epithelial and lymphoid cells; typical giant cells of the Langhans-Pirogov type have not been encountered.

EFFECTIVENESS OF BCG VACCINE AS A PROPHYLACTIC MEASURE AGAINST TUBERCULOSIS IN MINKS

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In order to study the antitubercular effectiveness of BCG vaccine under field conditions, we vaccinated more than 10,000 minks between 1971 and 1976 on various fur farms. In all cases, the BCG vaccine made by the Tashkent Institute of Vaccine and Serum for Intradermal Inoculation was used. Kittens aged 20-30 days (before weaning) were vaccinated intradermally using 0.02 mg of vaccine in the inner femoral surface, following the method developed by us.

This report gives the results of investigations carried out from 1972 to 1976 at the Nazyvaevsk Fur Cooperative in the Omsk region and on the Angrensk farm in the Uzbek Soviet Socialist Republic. The epizootic status on these farms was not the same. The Nazyvaevsk Fur Cooperative had remained susceptible to tuberculosis for over 15 years. A year before vaccination (1973), tuberculosis was established in 36.7% of the dead animals. In certain periods, the animals died exclusively of tuberculosis. On the Angrensk fur farm, tuberculosis was first noted in 1972, i.e., a year before administration of the vaccine. Early in 1973, the number of deaths due to tuberculosis rose sharply from 12.5% in January to 45.6% in March.

During the period of observation, no complications from the BCG vaccination were seen. The physiological growth of the vaccinated kittens was normal for their age, and did not differ from that of the unprotected kittens. Allergy investigations established a positive reaction after 30 days of vaccination in 50-70% of the minks, after two months in 75-80%, after five months in 50-65%, after eight months in isolated instances, and later dropped altogether.

On the Nazyvaevsk Fur Cooperative, 500 kittens were vaccinated in 1974. In this group, three died of tuberculosis within the first two months, but up to the end of the year no further deaths were reported. In the control groups during this same period, mink deaths due to tuberculosis numbered 141 or 30.5% of all deaths. Autopsies of the slaughtered vaccinated minks revealed tuberculosis infection in 3% of those tested, while it was found in 11.1% of the controls. In 1975, on this farm, 1,323 kittens of two divisions were vaccinated by the same method. At the time of slaughtering, only one vaccinated kitten had died of tuberculosis while 62 of those in the control

group had died, which was 12.4% of those dead. On selective autopsy of 100 vaccinated kittens (at the time of slaughtering), tuberculous infection was not found, while it was found in 12.7% of the controls (65 animals). In 1976, tuberculosis was not reported in any of the vaccinated kittens.

Similar results were also reported on the Angrensk fur farm where, in 1973, all of the kittens in a brigade (4,450 animals) were vaccinated. Among the vaccinated kittens, over a period of two years, tubercular infection was seen only in one. At the same time, in the control groups, in spite of the use of chemical prophylaxis and general antituberculosis measures, the infection was seen in 2.2% of the dead animals in 1973, and in 7.8% in 1974.

Thus, intradermal injection of BCG vaccine provides immunity to kittens for up to two years. Immunization by the BCG vaccine is innocuous, highly effective, and may be successfully used to control tuberculosis on fur farms.

BOTULISM IN MINKS

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Botulism is an extremely dangerous infection for minks. Prophylactic vaccination against this disease is compulsory on all fur farms. Until recently it was thought that minks were mainly susceptible to type C botulism toxin. As a result, vaccine against type C botulism was being produced and distributed by the Soviet biological industry.

However, reports have started appearing about outbreaks of botulism on fur farms caused by other types of toxins. T. I. Bulatova and V. N. Borisov (1968) and V. N. Borisov (1972) have reported a disease in minks caused by types E and A of *Cl. botulinum*. In 1963, on the Byelorussian state fur farm, 18,000 minks died, the source of infection was whale meat infected by type A of *Cl. botulinum*.

In 1974, on this same farm, we noticed an outbreak of botulism among minks caused by several types of toxins. Sickness and deaths of the animals started on September 16. On that day, 864 minks died, the next day 3,660, and on subsequent days 2,563, 1,000, 487, 189 and 139 animals. On September 23, 70 animals died and with this the deaths ceased. The deaths occurred in minks from four brigades which had received feed from the same batch. In the rest of the brigades, cases of infection were not reported. All of the farm-bred minks had been vaccinated against botulism, according to the required instructions.

The clinical symptoms were weak mobility of the animals, paresis of the pelvic limbs, weakening of the skeletal musculature, and enlargement of the pupils.

The pathological changes were characterized by congestive hyperemia of the liver and light cherry red color and swelling of the spleen. The kidneys were hyperemic and their profile smoothed in the cross section. The mucous of the stomach and intestine were hyperemic and covered with dense mucous.

Toxicological investigations of feed samples and material gathered from dead minks showed the absence of nitrates, nitrites, arsenic, zinc phosphide and organophosphorus compounds.

In bacteriological investigations carried out in the BelNIIEV and in the Republic and regional veterinary bacteriological laboratories the pathogens and toxin of botulism types A and E were isolated from the carcasses of the dead minks. Botulism toxins of types C and E were detected in the carcasses of animals sent to the VGNKI for expert investigation.

Cl botulinum, types A and E, were isolated from the first batch of feed samples on September 15. This batch of feed was supplied to the four brigades in which botulism occurred. The pathogen of anaerobic infection was not detected in the second batch of feed samples, which had been given to the minks in the other four brigades.

An outbreak of botulism similar to this occurred in July 1976, on the Iskra mink farm. About 5,000 animals died. Botulism toxin, types A, B, and E, were isolated from feed samples and from the carcasses of dead minks bacteriologically.

Conclusion

- 1 In the outbreaks of botulism in minks described above, the pathogens of diseases of types A, E, and B played a dominant role.

- 2 The antitoxin vaccine against botulism type C, produced indigenously, does not provide immunity in these cases.

- 3 An associated antibotulism vaccine should be developed.

OUTBREAK OF SIBERIAN ULCERS IN MINKS

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Siberian ulcers is a dangerous mammalian disease. In the outbreak of this disease described by us, the source of infection in minks was the meat of infected horses. The disease proceeded in a septic form. The incubation period varied from 2-3 hr to a day. The first symptoms of the disease were groaning, oral and nasal discharge of blood containing foam, and blood from the anus. Sometimes the minks died suddenly.

Pathoanatomical autopsy showed the following changes. There was slight stiffness, the animals were well fed, and the hairs around the mouth and nose were soiled with blood-containing foam. Large blood vessels were filled with tar-like uncoagulated blood. The spleen was enlarged more than 10 fold, its surface and cross section were blackish violet in color, its profile was smoothened, and pulp smeared. Lymphatic nodules were enlarged, blackish red in color, with hemorrhages. The visceral organs, brain and urinary bladder were filled with blood.

In blood films stained by the Giemsa method, large red bacilli were found surrounded by a colorless capsule in a grayish background. In smears stained by the Gram method, large bacilli were seen with chopped ends, heavily stained in a dark violet color. On staining the smears with Leffler's methylene blue, the bacilli acquired a bluish color, while the capsule took on a pale pink coloration.

Inoculations of infected tissue (from the heart, liver, spleen, brain, and intestine) on meat-peptone broth, meat-peptone agar, and Kiti-Tarocco media were incubated in a thermostat at 37.5°C for 18 to 24 hr. Under a microscope, at low magnification, colonies of bacilli were seen in the form of grayish white snow-flakes with lock-like spirals in the agar. The broth was transparent and a precipitate in the shape of tiny cotton pieces was seen at the bottom of the beaker. Bits of liver in the Kiti-Tarocco medium were surrounded by soft white cotton pieces. Determination of the sensitivity of the isolated Siberian ulcer micro-organism to antibiotics (penicillin, streptomycin, erythromycin, oxytetracycline, terramycin, tetracycline, monomycin, neomycin, chloromycetin, and oleandomycin phosphate) established its high sensitivity to tetracycline.

EXPERIMENTAL INFECTION OF GESTATING FEMALE BLUE FOXES BY *E COLI* CULTURE

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We studied 134 fecal samples from clinically healthy blue foxes, visceral and sex organs from 42 discarded and slaughtered females and 160 carcasses from aborted, stillborn and other kittens dead before or after registration. By bacteriological and biochemical investigations of 336 pathological samples of blue foxes, 118 cultures of *E coli* were isolated, 25 of these were pathogenic to the laboratory animals. Serologically, five of the 25 cultures of *E coli* were put in the 0111 serotype.

To determine the pathogenic and toxic properties of type 0111 *E coli* cultures, 1 ml containing one billion bacterial cells, 10 white mice were infected with 200,000 to 500,000 bacterial cells subcutaneously, six hybrid silver-black foxes with 10 to 20 billion bacterial cells intramuscularly, and six female blue foxes in the first and second stages of gestation with three billion bacterial cells each intramuscularly.

The white mice died in 18-36 hr. Resorption of the embryos occurred in the female blue foxes that were in the first stage of gestation (histological examination of the uterus showed placental remnants). The females in the second half of gestation aborted. No clinical symptoms of the disease appeared in the hybrid silver-black foxes during the period of observation.

The original *E coli* culture was isolated bacteriologically from the dead white mice. No bacterial infection could be isolated from the visceral and sex organs of killed blue foxes and hybrid silver-black foxes.

Thus, these investigations showed that the isolated cultures of *E coli*, type 0111, were pathogenic and toxic to white mice and pregnant blue foxes.

The *E coli*, type 0111, strain is probably one of the reasons for abortions among blue foxes.

STUDY OF COCCIDIAL INFECTION IN MINKS

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This report gives the results of studies on the pathological material gathered from minks suffering from spontaneous or experimentally induced coccidial infection.

These investigations were carried out on 15 carcasses of minks which had died of natural coccidial infection, and 19 dead or killed minks with induced infection.

Coccidial hemolytic cultures pathogenic to white mice and minks were isolated from minks (brain, heart, liver, spleen and intestine) by bacteriological investigation of the pathological material received from two state fur farms. The isolated cultures were fermented with the formation of glucose, maltose, lactose, and saccharose, and thinned gelation. They were sensitive to penicillin, erythromycin, streptomycin, neomycin, monomycin, and oleandomycin phosphate.

It should be pointed out that the cultures isolated from minks with acute infection and not treated with antibiotics caused the death of experimentally infected animals within a few hours to one day. The animals showed a pathoanatomical pattern of hemodynamic disturbance in the organs. The pathomorphological changes in minks with either spontaneous or experimentally induced infection were monotypical. Prominent among these were infection of the blood vessels of the brain, dilatation of the heart, hyperplasia of the spleen with hemorrhages in the seen red pulp, sharply manifested congestive hyperemia of the cortical layer of the kidneys, lymphoex-travasation into the connective tissue of the organ, serous edema of the connective tissue, breakdown of the proteins with their discomplexation, hemorrhagic enteritis, and swelling and hemorrhage in the central portion of the mesenteric lymph nodes. When the minks were infected spontaneously, there was also accumulation of neutrophils in the hepatic interstices.

Biological tests were carried out on the coccidial infection isolated from minks which had suffered from the disease for a long period (48 to 96 hr), and from naturally sick and experimentally induced minks, all of which had been treated by antibiotics. These showed a highly prolonged incubation period and the development of dystrophic changes in the organs. Diffuse adiposity of the epithelium of convoluted tubules, with the death of some epithelial nuclei, were found in the kidneys, while adiposity in the form of fine droplets of fat with microportions of fatty detritus were seen in the liver, and hyperplasia and infarction in the spleen. In the intestine there was mucous

catarrhal enteritis with infiltrations of the base of the mucous by neutrophilic leukocytes; in the mesenterial lymph nodes lymphadenitis could be seen with an accumulation of desquamated cells of the reticuloendothelial system, and neutrophils were present in the enlarged brain sinuses.

Thus, these data point to coccidial infection as a factor responsible for the death of minks.

POPULATION ANALYSIS OF *TOXASCARIS LEONINA* IN FARM-BRED BLUE FOXES

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The helminth fauna composition in farm-bred blue foxes in Karelia shows a high incidence of infection by *Toxascaris leonina* (Linstow, 1902 and Leiper, 1907)

The population dynamics of the parasite are discussed here. This material was gathered between July and November 1976, on one of the state fur farms in Karelia. The study covered 108 fur-bearing animals (82 kits and 26 adult females). The animals infected by nematodes were identified by the presence of eggs in the feces (Fulleborn method). The data of coprological analysis were confirmed by autopsy of the slaughtered animals.

It was found that 67% of the kittens and 30% of the adult females were infected by carnivorous Ascaridae, the intensity of infection being 1-39 nematodes per animal.

One characteristic of the parasite-host relationship between *T. leonina* and blue foxes is the adaptation of the Ascarids to parasiting a host system rigidly controlled by man. The distribution of parasites in an artificially infected host is extremely uneven and follows the negative binomial relationship $S^2/M = 15.7$ (S^2 is the dispersion and M the average population of parasites in one host animal).

It was found that under conditions of nearly equal abundance of parasites (intensity of infection of adult females 9.3 and of kittens 7.2 helminths per host animal), nematode aggregation differed significantly in the adults and young animals ($K_1 = 0.14$ and $K_2 = 0.25$ respectively). Thus, the possibility of infection of blue foxes by *T. leonina* varies with age, a probable reason for this being the development of immunity with age.

The absence of hyperinvasions and the uneven distribution of parasites in kittens ($S^2/M = 15.9$) needs to be explained. Identical conditions of rearing, and animals of the same age group, should result in an equal probability of infection. Evidently, in this situation, nonsterile immunity comes into play in regulating the population.

Thus, age and nonsterile immunity are the probable population regulators of *T. leonina* parasitization of blue foxes.

LABORATORY INVESTIGATIONS OF IMMUNITY IN FUR-BEARING ANIMALS VACCINATED BY AEROSOL AGAINST CANINE DISTEMPER

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Large scale vaccinations of fur bearing animals by aerosol present certain difficulties and call for the development of easily accessible laboratory techniques to evaluate the effectiveness of vaccinations. During the present investigations, vaccinated animals were infected by a virulent strain of the virus, which is not suitable for field use. The most suitable methods for analysing the immunity state are based on determining the ratio of antibodies to the homologous antigen in the blood serum.

The present report deals with immunity in minks, polecats, and blue and silver black foxes vaccinated against canine distemper. Immunity was evaluated by the presence of antibodies in the blood serum as determined by neutralization reaction (RN), complement fixation test (RSK), and passive hemagglutination reaction (RPGA). A correlation was found between the level of antibodies and the immunity of animals to controlled infection.

Experiments were carried out with virus-vaccine cultures of strain 668-KF-A developed by the VNIIVViM for aerosol application. Two- to three-month-old animals obtained from farms free of infectious diseases were used for the immunization tests. Vaccination was carried out in doses of 250 to 600 ID₅₀, using the aerosol generator SAG-1-RN. The activity level of the vaccine was determined by the immunoperoxidase method, immunofluorescence reaction, and hemadsorption of the virus processed for titration in a culture of chicken embryo cells.

No deviations from the physiological norm were seen in animals vaccinated by aerosol. The blood serum of both vaccinated and control animals was investigated on the 21st day.

The titer of virus neutralizing antibodies in the blood serum of minks and polecats was established in dilutions of 1/20 to 1/60 and of silver black and blue foxes, 1/10 to 1/80. Standard, purified and concentrated antigens and sera obtained with canine distemper virus were used for the RSK and RPGA. The complement fixative antibodies were detected in titers 1/8 to 1/32 for minks and polecats and 1/16 to 1/64 for blue and silver-black foxes. The results of the RPGA corresponded to the titers of complement fixative antibodies or were 10 times higher.

Vaccinated and control animals were infected with virulent strains of

canine distemper virus, in doses of 100-1,000 ID₅₀/ml. Minks and polecats were administered the Byelorussk strain while blue and silver black foxes were administered the Guayazsk strain. Before infection, the minks were irradiated by γ -rays at a dosage of 140-160 roentgens. The test animals were under observation for 30 days. In animals with blood serums which had virus neutralizing antibodies less than 1:20 and RSK and RPGA 1:8, the clinical symptoms of canine distemper (rhinitis, conjunctivitis, and dermatitis), followed by death, occurred from the 14th to the 28th day. In animals which had antibodies in the titers 1:8 and above in RSK and RPGA and in RN 1:20 and above, clinical symptoms and death due to distemper did not occur.

Thus, these investigations lead to the conclusion that vaccine by aerosol application possesses no reactivity and results in high immunity, which can be assessed serologically. A direct correlation was established between the titers of antibodies in the blood serum of vaccinated animals and their resistance to canine distemper.

SPECIFIC RESPONSE OF MUSTELIDS TO FUNGAL PATHOGENS

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In nature as well as in farm breeding, members of the family Mustelidae come into close contact with the fungal pathogens that cause natural and localized diseases in rodents. The end result of these interrelationships depends on the response level of the animals.

The susceptibility of Mustelidae to infection by the pathogens of dermatomycosis (*Trichophyton mantagrophytes*) and trichosporomycosis (*Emmonsiacrescens*) in the laboratory and in nature has been studied.

Siberian weasels, weasels, and Alpine weasels were totally unreactive to the application of gypsum-like *Trichophyton*, and rapid hair growth was noticed. Ferrets showed rapid skin erythema. Polecats responded by reddening of the skin and sometimes skin edema with itching and exudation, moreover, spores of fungi were seen on the scales. Signs of inflammation disappeared within a week. Ermine responded to the infection by reddening of the skin and in some specimens there was hair loss over large areas far from the site of infection. The skin nevertheless preserved its elasticity without visible signs of inflammation.

Isolation of the fungi from the animals on the 14th and 25th days after infection was unsuccessful. There was not a single instance of damage to the hair.

The results of observations help to classify Mustelidae in animals which are not susceptible to dermatomycosis. The reasons for this congenital immunity are not known. Unsaturated fatty acids in the sebaceous gland secretions, as shown by the experiments, are fungicidal to the pathogen of dermatomycosis. However, similar investigations of the wool fat of other animals (rodents and insectivores) showed significant variability in the fungicidal property (presence in susceptible species and absence in immune species of animals). Consequently, the fungicidal property of wool fat alone cannot explain the characteristic response of Mustelidae to infection. Differences in the chemical composition of the keratin of hair (if at all it is possible) also cannot be a factor responsible for the nonsusceptibility of these animals. Taking into consideration the resistance of Mustelidae to other infections (tularemia, salmonellosis, and others), it can only be assumed that these species of animals, during the course of evolution, acquired group nonspecific immunity to infections of different etiologies.

Based on the widespread distribution of the disease (EB) during adiaspiromycosis, and the intensity of infection (IZ), Mustelidae have been classified by the author as susceptible to infection. Thus, for sables, the EB in some regions goes up to 76% and the IZ to 1,142 parasitic fungi (adidaspores) per infected lung.

Mustelidae have an extremely characteristic response to infection by *E. crescens*. From the seventh to the 14th day after infection by inhalation, inflammatory centers 300 to 500 μm in diameter formed around the fungal elements. Extensive and dense infiltrates hinder the conversion of the fungal conidium into an adult adiaspore. While in rodents, which do not show such a response, the adult adiaspores grow to a diameter of 500 μm or more, their size in Mustelidae rarely reaches 200 to 350 μm .

The increased reactivity of Mustelidae during adiaspiromycosis should be regarded as a protective mechanism limiting the action of the pathogen. If, however, the adiaspores were to reach their final size in these animals, a significant part of the lung tissue would be in a state of necrosis or necrobiosis due to the high IZ indexes and only some portions would remain functional. In fact, this is not so. Evidently, the disease takes hold when the overall state of the organism is weak, although no clear correlation can be established between the IZ and the healthy condition of the animals.

BIOLOGICAL AND IMMUNOLOGICAL PROPERTIES OF ADSORBED PARATYPHOID ANTIGENS AFTER PROLONGED STORAGE

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A mixture of whole paratyphoid antigens adsorbed on aluminum hydroxide by typhimurium, enteritidis, and choleresus prepared in the laboratory by the author was stored for 18 months at a temperature of $+2$ to $+3^{\circ}\text{C}$ in hermetically sealed flasks 50 and 100 ml in capacity. On examination, the flasks showed no molds, undissociated clumps of aluminum hydroxide, or color or consistency changes in the preparations.

The immunogenetic ability of the stored mixture of antigens was tested on 75 white mice weighing 13–16 g, divided into 12 experimental and three control groups each consisting of five mice. The mixture of adsorbed antigens was administered to the experimental mice intramuscularly in the femoral region at 0.2 ml per animal. The controls were not immunized.

Table 1. Immunogenicity of mixtures of adsorbed paratyphoid antigens

Group of mice	Dose of micro-organisms	No. of mice	No. of mice		Cumulative data		% of mortality
			surviving	dead	surviving	dead	
Infection by typhimurium culture							
I	10	5	3	2	9	2	18
II	100	5	4	1	6	3	33
III	1,000	5	2	3	2	6	75
IV	10,000	5	0	5	0	11	100
Infection by choleresus							
I	2	5	2	3	5	3	37
II	20	5	2	3	3	6	67
III	200	5	1	4	1	10	90
IV	2,000	5	0	5	0	15	100
Infection by enteritidis culture							
I	2	5	1	4	5	4	44
II	20	5	2	3	4	7	64
III	200	5	2	3	2	10	83
IV	2,000	5	0	5	0	15	100

Fourteen days later, the experimental mice were infected intraperitoneally with different paratyphoid cultures given in daily doses. The control group of mice were infected (after preliminary titration) with fatal doses intraperitoneally. The concentration of micro-organisms was established by the optical turbidity standard. Calculations using Ried and Mench's equation (from the percentage of lethality) established that the infecting dose causing 50% fatality (LD_{50}) in immunized mice was 254 micro-organisms for typhimurium and 3.66 microbe bodies for choleresuis and enteritidis. Complete data on the lethality of experimental mice infected by different doses of paratyphoid cultures are given in Table 1.

From the above test results, it may be concluded that the administration of mixtures of paratyphoid antigens to mice showed that typhimurium enteritidis and choleresuis, after 18 months of storage, provided resistance to infection. This enhanced the fatal typhimurium dose by 254 times, enteritidis by 3.66 times, and choleresuis by 6.3 times.

ISOLATION OF IMMUNOGLOBULINS IgG AND IgM FROM THE BLOOD SERUM OF BLUE FOXES

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Much attention has been given to the study of the structures and properties of antibodies and also to the isolation of classes and subclasses of immunoglobulins. More is known about immunoglobulins in man (Grey and Kunkel, 1964, Terry and Fahey, 1964, and others) than those in mice, rats, dogs and Equidae (Bloch et al, 1968, Bristany and Tomasi, 1970, Allen and Dalton, 1975, and others).

Little is known about immunoglobulins in fur bearing animals, including minks and blue foxes. Immunoglobulins in minks were studied only in relation to infection by plasmocytosis virus, i.e., Aleutian disease (Tabel and Ingram, 1972).

In immunological investigations, it is often necessary to establish not only the qualitative composition but also the quantitative ratios of immunoglobulins in the blood serum or tissues. The radial immunodiffusion method suggested by Mancini et al, 1965 is extensively used for quantitative determinations. This method needs specific standard antisera. However, such antisera are not being produced by indigenous biological laboratories.

The object of the present investigation was to develop a method to isolate immunoglobulins from the blood serum of blue foxes, and also to produce homologous antisera.

In this work the method proposed for isolating canine immunoglobulins (Thumel, 1975) was used. After the globulin fraction of the blood serum, the precipitate was subjected to dialysis and later to gel filtration on a Sephadex G-200. Gel filtration of whole serum was done for purposes of comparison.

The homogeneity of eluted fractions was tested by horizontal electrophoresis in agar gel and vertical electrophoresis in polyacrylamide gel.

It was established that preliminary salting significantly improved the homogeneity of the resultant fractions. IgG for use as an antigen called for further purification on a DEAE Sephadex A-50. The IgM thus isolated did not contain admixtures of other immunoglobulins and could be used for producing antisera.

Thus, the method proposed for the isolation of immunoglobulins from canine blood serum can be successfully used to produce IgM and IgG from the serum of blue foxes, but preliminary salting of the globulin fraction must invariably be carried out.

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